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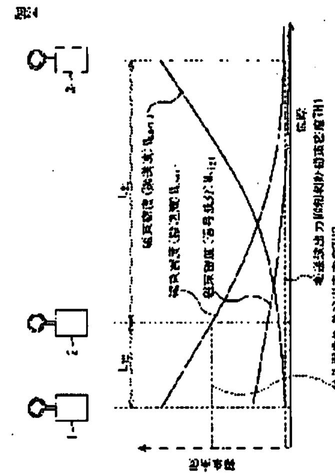
(54) SYSTEM, APPARATUS AND METHOD FOR COMMUNICATION



(57)Abstract:

PROBLEM TO BE SOLVED: To provide a communication system, a communication apparatus and a communication method capable of easily solving a so-called hidden terminal problem caused in radio communication such as short-range communication.

SOLUTION: Communication apparatuses 1, 3 determine whether an electromagnetic wave of a level equal to or higher than carrier wave output suppression determining magnetic flux density TH1. When the electromagnetic wave of the level equal to or higher than the carrier wave output suppression determining magnetic flux density TH1 has not been detected, the apparatuses 1, 3 start to output an electromagnetic wave. On the contrary, to obtain data via the electromagnetic wave, a communication apparatus 2 needs an electromagnetic wave of a level equal to or higher than carrier wave output suppression determining magnetic flux density TH2 higher than the carrier wave output suppression determining magnetic flux density TH1. This system is applicable to e.g. an IC card system etc.

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CLAIMS

[Claim(s)]

[Claim 1]

In the communication system which consists of the 1st and the 2nd communication device,

Said 1st and 2nd communication devices,

A modulation means to transmit data at the transmission rate of either of two or more transmission rates by modulating an electromagnetic wave,

A recovery means to acquire the data transmitted from other equipments at the transmission rate of either of two or more transmission rates by restoring to an electromagnetic wave,

A detection means to detect an electromagnetic wave

Preparation,

Said 1st communication device starts the output of an electromagnetic wave, when the electromagnetic wave of the level beyond the 1st threshold is not detected in said detection means,

Said 2nd communication device needs the electromagnetic wave of the level beyond the 2nd adult threshold from said 1st threshold, although data are acquired in said recovery means.

Communication system characterized by things.

[Claim 2]

Said detection means detects the electromagnetic wave of the level beyond said 1st threshold, and the electromagnetic wave of the level beyond said 2nd threshold,

Said 2nd communication device acquires data in said recovery means, when the electromagnetic wave of the level beyond the 2nd threshold is detected in said detection means.

Communication system according to claim 1 characterized by things.

[Claim 3]

Said 1st and 2nd communication devices are further equipped with a threshold setting means to set up the threshold of the level of the electromagnetic wave which said detection means is made to detect,

Said detection means detects the electromagnetic wave of the level beyond said threshold of 1, and the electromagnetic wave of the level beyond said 2nd threshold according to the threshold set up by said threshold setting means.

Communication system according to claim 2 characterized by things.

[Claim 4]

Said the 1st and 2nd threshold are set up so that it may hide and a terminal problem may not arise.

Communication system according to claim 1 characterized by things.

[Claim 5]

Transmission and reception of the data based on said electromagnetic wave are performed through a coiled form antenna.

Communication system according to claim 1 characterized by things.

[Claim 6]

In the communication device which transmits and receives data by carrying out the strange recovery of the electromagnetic wave,

An electromagnetic wave generating means to form RF (Radio Frequency) field by generating an electromagnetic wave,

A modulation means to transmit data at the transmission rate of either of two or more transmission rates by modulating an electromagnetic wave,

A recovery means to acquire the data transmitted from other equipments at the transmission rate of either of two or more transmission rates by restoring to an electromagnetic wave,

A detection means to detect an electromagnetic wave

Preparation,

When the electromagnetic wave of the level beyond the 1st threshold is not detected in said detection means, the output of an electromagnetic wave is started,

The electromagnetic wave communicates with the equipment besides the above in the

location which reaches on the level beyond the 2nd adult threshold from said 1st threshold.

The communication device characterized by things.

[Claim 7]

In the correspondence procedure which transmits and receives data by carrying out the strange recovery of the electromagnetic wave,

The electromagnetic wave generating step which forms RF (Radio Frequency) field by generating an electromagnetic wave,

The modulation step which transmits data at the transmission rate of either of two or more transmission rates by modulating an electromagnetic wave,

The recovery step which acquires the data transmitted from other equipments at the transmission rate of either of two or more transmission rates by restoring to an electromagnetic wave,

The detection step which detects an electromagnetic wave

Preparation,

When the electromagnetic wave of the level beyond the 1st threshold is not detected in said detection step, the output of an electromagnetic wave is started,

The electromagnetic wave communicates with the equipment besides the above in the location which reaches on the level beyond the 2nd adult threshold from said 1st threshold.

The correspondence procedure characterized by things.

[Claim 8]

In the communication device which transmits and receives data by carrying out the strange recovery of the electromagnetic wave,

A modulation means to transmit data at the transmission rate of either of two or more transmission rates by modulating an electromagnetic wave,

A recovery means to acquire the data transmitted from other equipments at the transmission rate of either of two or more transmission rates by restoring to an electromagnetic wave,

Preparation,

said — others — when equipment checks that the electromagnetic wave of the level beyond the 1st threshold does not exist and starts the output of an electromagnetic wave, although data are acquired in said recovery means, the electromagnetic wave of the level beyond the 2nd adult threshold is needed from said 1st threshold

The communication device characterized by things.

[Claim 9]

It has further a detection means to detect an electromagnetic wave,

When the electromagnetic wave of the level beyond the 2nd threshold is detected in said detection means, data are acquired in said recovery means.

The communication device according to claim 8 characterized by things.

[Claim 10]

By generating an electromagnetic wave, it has further an electromagnetic wave generating means to form RF (Radio Frequency) field,

Said modulation means transmits data by modulating the electromagnetic wave which said electromagnetic wave generating means outputs,

Said detection means detects the electromagnetic wave of the level beyond said 1st threshold, and the electromagnetic wave of the level beyond said 2nd threshold,

When the electromagnetic wave of the level beyond the 1st threshold is not detected in said detection means, the output of the electromagnetic wave by said electromagnetic wave generating means is started.

The communication device according to claim 9 characterized by things.

[Claim 11]

Said modulation means transmits data by carrying out the load modulation of the electromagnetic wave which equipment besides the above generates.

The communication device according to claim 8 characterized by things.

[Claim 12]

In the correspondence procedure which transmits and receives data by carrying out the strange recovery of the electromagnetic wave,

The modulation step which transmits data at the transmission rate of either of two or more transmission rates by modulating an electromagnetic wave,

The recovery step which acquires the data transmitted from other equipments at the transmission rate of either of two or more transmission rates by restoring to an electromagnetic wave,

Preparation,

said — others — when equipment checks that the electromagnetic wave of the level beyond the 1st threshold does not exist and starts the output of an electromagnetic wave, although data are acquired in said recovery step, the electromagnetic wave of the level beyond the 2nd adult threshold is needed from said 1st threshold

The correspondence procedure characterized by things.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

Especially this invention relates to the so-called communication system which is produced in radio, such as for example, a contiguity communication link, about a communication device and a correspondence procedure in communication system and a list and which hides and enables it to solve a terminal problem easily, and a list at a communication device and a correspondence procedure.

[0002]

[Description of the Prior Art]

As a system which performs a contiguity communication link, IC (Integrated Curcuit) system is known widely, for example. In IC card system, when reader/writer generates an electromagnetic wave, the so-called RF (Radio Frequency) field (field) is formed. And by electromagnetic induction, if an IC card approaches reader/writer, an IC card will perform data transmission between reader/writers while receiving supply of a power source.

[0003]

By the way, as a specification of IC card system by which current operation is carried out, there are some which are called Type A, Type B, and Type C, for example.

[0004]

Type A is adopted as Philips's MIFARE method, encoding of the data based on Miller is carried out to the data transmission from reader/writer to an IC card, and encoding of the data based on Manchester is carried out to the data transmission from an IC card to reader/writer at it. Moreover, by Type A, 106kbps (kilo bit per second) is adopted as a transmission rate of data.

[0005]

By Type B, encoding of the data based on NRZ is carried out to the data transmission from reader/writer to an IC card, and encoding of the data twisted for the data transmission from an IC card to reader/writer NRZ-L is carried out to it. Moreover, by Type B, 106kbps is adopted as a transmission rate of data.

[0006]

Type C is adopted as a FeliCa method of Sony Corp. which is this applicant, and encoding of the data based on Manchester is carried out to the data transmission between reader/writer and an IC card. Moreover, by Type C, 212kbps is adopted as a transmission rate of data.

[0007]

By the way, in radio, such as a contiguity communication link, since [so-called] it hides and a terminal problem arises, how it corresponds to it poses a problem.

[0008]

For example, in the system of the conventional wireless LAN (Local Area Network), generally, it is exchanging Commands RTS (Request to send) and CTS (Clear to send) during data communication, and it hides and the terminal problem is coped with (for example, nonpatent literature 1).

[0009]

Here, it hides and, generally a terminal problem means the following problems.

[0010]

That is, in radio, in case it is going to transmit to the communication device of another side from one side of them about two or more communication devices, control is performed so that an electric wave (electromagnetic wave) may not be taken out to coincidence. The communication device which is going to output the electric wave does not output an electric wave, when a surrounding electric wave is detected and an electric wave is detected around, but when an electric wave is not detected around, specifically, it outputs an electromagnetic wave. Thereby, one communication device and the communication device of another side share an electric wave by turns, and exchange data.

[0011]

As mentioned above, when the communication device which is going to output the electric wave performs the output control of the electric wave by self only by the existence of detection of a surrounding electromagnetic wave, the situation that data are transmitted to coincidence from two or more of other communication devices may occur to a certain communication device, and reception of data may go wrong in a

certain communication device.

[0012]

That is, suppose that three communication devices A, B, and C exist now. And communication devices A and B presuppose that communication devices B and C are also in the distance which can carry out use control of the electric wave exclusively among both while being in the distance which can carry out use control of the electric wave exclusively among both. However, communication devices A and C presuppose that there is nothing in the distance which can carry out use control of the electric wave exclusively among both.

[0013]

In this case, a communication device B cannot output an electric wave, while outputting the electric wave with either the communication device A or the communication devices C. However, a communication device A can output an electric wave, even if the communication device C is outputting the electric wave. A communication device A can output an electric wave for it, even if the communication device C is outputting the electric wave.

[0014]

When communication devices A and C are in the above physical relationship, an electric wave (data) may be transmitted to coincidence from both communication devices A and C to a communication device B. And if the distance from a communication device B to each of communication devices A and C is equal and communication devices A and C, for example, output the electric wave of the same reinforcement, in a communication device B, the data with which the electric wave outputted from each of communication devices A and C is received by the same reinforcement, consequently communication devices A and C are transmitted by interference either are also normally unreceivable.

[0015]

As mentioned above, from a communication device A, that a communication device B cannot receive data normally cannot check existence of a communication device C, although existence of a communication device B can be checked, but although existence of a communication device B can be checked also from a communication device C, it originates in the ability of existence of a communication device A not to be checked. Thus, another side originates in hiding so to speak and it not being visible from each of communication devices A and C, and in a communication device B, by outputting an electric wave to coincidence from communication devices A and C, the problem which interference produces hides and is called a terminal problem.

[0016]

So, in the conventional wireless LAN, the communication device of the communication link origin which starts a communication link transmits the command RTS which reports communication link time amount (space occupancy time amount) etc. to the communication device of a communications partner.

The communication device of the communications partner which received Command RTS returns the command CTS which reports the comprehension to Command RTS, communication link time amount (space occupancy time amount), etc. to the communication device of a communicating agency. Other communication devices which are in the distance which can receive the commands RTS or CTS by the communicating agency or the communication device of a communications partner recognize occupancy of the space between a certain space occupancy time amount with the commands RTS or CTS, and it refrains from transmission of an electric wave (data) between the space occupancy time amount.

[0017]

In the communication devices A and C in above-mentioned physical relationship, a communication device A transmits Command RTS to a communication device B, and a communication device B transmits the command CTS as a response to the command RTS to a communication device A. A communication device C can receive the command CTS which the communication device B transmitted, and if a communication device C receives the command CTS which the communication device B transmitted, it is avoidable that the electric wave (data) from communication devices A and C collides sending out of an electric wave in bracing, consequently a communication device B.

[0018]

[Nonpatent literature 1]

ANSI/IEEE Std 802.11, 1999 Edition, LOCAL AND METROPOLITAN AREA NETWORKS: WIRELESS LAN and Chapter 9 MAC sublayer functional description

[0019]

[Problem(s) to be Solved by the Invention]

However, it hid, and the solution technique of a terminal problem needed control logic, memory, etc. for it for the communication device, and had the technical problem by Commands RTS and CTS in which cost goes up.

[0020]

This invention is made in view of such a situation, hides, and enables it to solve a terminal problem easily.

[0021]

[Means for Solving the Problem]

The communication system of this invention starts the output of an electromagnetic wave, when, as for the 1st communication device, the electromagnetic wave of the level beyond the 1st threshold is not detected in the detection means, and the 2nd communication device is characterized by needing the electromagnetic wave of the level beyond the 2nd adult threshold from the 1st threshold, although data are acquired in a recovery means.

[0022]

It is characterized by the 1st communication device of this invention communicating with other equipments in the location at which the output of an electromagnetic wave is started and the electromagnetic wave arrives on the level beyond the 2nd adult threshold from the 1st threshold, when the electromagnetic wave of the level beyond the 1st threshold is not detected in the detection means.

[0023]

It is characterized by communicating with other equipments which the 1st correspondence procedure of this invention has in the location at which the output of an electromagnetic wave is started and the electromagnetic wave arrives on the level beyond the 2nd adult threshold from the 1st threshold when the electromagnetic wave of the level beyond the 1st threshold is not detected in the detection step.

[0024]

The 2nd communication device of this invention is characterized by needing the electromagnetic wave of the level beyond the 2nd adult threshold from the 1st threshold, although data are acquired in a recovery means, when other equipments check that the electromagnetic wave of the level beyond the 1st threshold does not exist and start the output of an electromagnetic wave.

[0025]

The 2nd correspondence procedure of this invention is characterized by needing the electromagnetic wave of the level beyond the 2nd adult threshold from the 1st threshold, although data are acquired in a recovery step, when other equipments check that the electromagnetic wave of the level beyond the 1st threshold does not exist and start the output of an electromagnetic wave.

[0026]

In the communication system of this invention, when, as for the 1st communication device, the electromagnetic wave of the level beyond the 1st threshold is not detected, the output of an electromagnetic wave is started, and the 2nd communication device needs the electromagnetic wave of the level beyond the 2nd adult threshold from the 1st threshold, although data are acquired.

[0027]

In the 1st communication device and correspondence procedure of this invention, when the electromagnetic wave of the level beyond the 1st threshold is not detected, the output of an electromagnetic wave is started and other equipments and communication link which have the electromagnetic wave in the location which reaches on the level beyond the 2nd adult threshold from the 1st threshold are performed.

[0028]

In the 2nd communication device and correspondence procedure of this invention, when other equipments check that the electromagnetic wave of the level beyond the 1st threshold does not exist and start the output of an electromagnetic wave, although data are acquired, the electromagnetic wave of the level beyond the 2nd adult threshold is needed from the 1st threshold.

[0029]

[Embodiment of the Invention]

Drawing 1 shows the example of a configuration of the gestalt of 1 operation of the communication system (a system means the thing object which two or more equipments combined logically, and it does not ask whether the equipment of each configuration is in the same case) which applied this invention.

[0030]

In drawing 1 , communication system consists of three NFC communication devices 1, 2, and 3. the NFC communication device 1 thru/or 3 -- each can perform now the contiguity communication link (NFC (Near Field Communication)) by electromagnetic induction which used the subcarrier of a single frequency among other NFC communication devices.

[0031]

Here, as a frequency of the subcarrier which the NFC communication device 1 thru/or 3 use, 13.56 etc.MHz of an ISM (Industrial Scientific Medical) band etc. is employable, for example.

[0032]

Moreover, the communication link which means, and the equipments (case) which communicate contact and performs the communication link from which the distance of the equipments with which a contiguity communication link communicates is set to less than several 10cm, and becomes possible is also included.

[0033]
in addition, a thing employable as an IC card system which uses one or more [other] as an IC card while the communication system of drawing 1 makes reader/writer the NFC communication device 1 thru/or 1 or more [of 3] — of course -- the NFC communication device 1 thru/or 3 — it is also possible to adopt each as communication system, such as PDA (Personal Digital Assistant), PC (Personal Computer), a cellular phone, a wrist watch, and a pen. That is, the NFC communication device 1 thru/or 3 are equipment which performs a contiguity communication link, and is not limited to an IC card, reader/writer, etc. of IC card system.
[0034]
The NFC communication device 1 thru/or 3 have two descriptions that the communication link by the two communicate modes is possible to the 1st, and that the data transmission by two or more transmission rates is possible to the 2nd.
[0035]
There are the passive mode and the active mode as the two communicate modes. When it takes notice of the communication link between the NFC communication device 1 thru/or the NFC communication devices 1 and 2 of 3 now, in the passive mode The NFC communication device 1 which is one NFC communication device of the NFC communication devices 1 and 2 like the conventional IC card system mentioned above Data are transmitted to the NFC communication device 2 which is a NFC communication device of another side by modulating the electromagnetic wave (corresponding subcarrier) which self generates. The NFC communication device 2 By carrying out the load modulation of the electromagnetic wave (corresponding subcarrier) which the NFC communication device 1 generates, data are transmitted to the NFC communication device 1.
[0036]
On the other hand, in the active mode, all of the NFC communication devices 1 and 2 transmit data by modulating the electromagnetic wave (corresponding subcarrier) which self generates.
[0037]
When performing the contiguity communication link by electromagnetic induction here, an electromagnetic wave is outputted first, a communication link is started, and the equipment which has the communicative leadership so to speak is called an initiator. An initiator transmits a command to a communications partner, and although the communications partner is the form where the response to the command is returned and a contiguity communication link is performed, it calls a target the communications partner which returns the response to the command from an initiator.
[0038]
For example, supposing the NFC communication device 1 starts the output of an electromagnetic wave and starts the communication link with the NFC communication device 2 now, as shown in drawing 2 and drawing 3 , the NFC communication device 1 will serve as an initiator, and the NFC communication device 2 will serve as a target.
[0039]
And the NFC communication device 1 which is an initiator as shown in drawing 2 in the passive mode outputs an electromagnetic wave continuously, and while the NFC communication device 1 transmits data to the NFC communication device 2 which is a target by modulating the electromagnetic wave which self is outputting, the NFC communication device 2 transmits data to the NFC communication device 1 by carrying out the load modulation of the electromagnetic wave which the NFC communication device 1 which is an initiator is outputting.
[0040]
On the other hand, in the active mode, as shown in drawing 3 , the NFC communication device 1 which is an initiator transmits data to the NFC communication device 2 which is a target by starting the output of an electromagnetic wave in person and modulating the electromagnetic wave, when self transmits data. And the NFC communication device 1 suspends the output of an electromagnetic wave after transmitting termination of data. When self transmits data, and the NFC communication device 2 which is a target also starts the output of an electromagnetic wave in person and modulates the electromagnetic wave, data are transmitted to the NFC communication device 2 which is a target. And the NFC communication device 2 suspends the output of an electromagnetic wave after transmitting termination of data.
[0041]
In addition, the NFC communication device 1 thru/or 3 mention later about the 2nd focus that the data transmission by two or more transmission rates is possible.
[0042]
Moreover, although communication system is constituted from drawing 1 by three NFC communication devices 1 thru/or 3, the NFC communication device which constitutes communication system may not be limited to three, and may be 2 or 4 or more. Furthermore, communication system can also be constituted including an IC card, reader/writer, etc. which constitute other, for example, the conventional IC, card systems [communication device / NFC].

[0043]

Next, drawing 4 shows the example of a configuration of the NFC communication device 1 of drawing 1 . In addition, since other NFC communication devices 2 and 3 of drawing 1 as well as the NFC communication device 1 of drawing 4 are constituted, the explanation is omitted.

[0044]

The antenna 11 constitutes the coil of a closed loop, is that the current which flows in this coil changes, and outputs an electromagnetic wave. Moreover, a current flows at an antenna 11 because the magnetic flux which passes along the coil as an antenna 11 changes.

[0045]

A receive section 12 receives the current which flows at an antenna 11, performs alignment and detection, and outputs to the recovery section 13. The recovery section 13 restores to the signal supplied from a receive section 12, and supplies it to the decoding section 14. The decoding section 14 decodes the Manchester code as a signal supplied from the recovery section 13 etc., and supplies the data obtained as a result of the decoding to the data-processing section 15.

[0046]

The data-processing section 15 performs predetermined processing based on the data supplied from the decoding section 14. Moreover, the data-processing section 15 supplies the data which should be transmitted to other equipments to the encoding section 16.

[0047]

The encoding section 16 encodes the data supplied from the data-processing section 15 to a Manchester code etc., and supplies them to the selection section 17. The selection section 17 chooses either the modulation section 19 or the load modulation sections 20, and outputs the signal supplied to the selected one of it from the encoding section 16.

[0048]

Here, the selection section 17 chooses the modulation section 19 or the load modulation section 20 according to control of a control section 21. The communicate mode is the passive mode, and a control section 21 makes the load modulation section 20 choose it as the selection section 17, when the NFC communication device 1 serves as a target. Moreover, a control section 21 makes the modulation section 19 choose it as the selection section 17, when the communicate mode is the active mode, or when the communicate mode is the passive mode and the NFC communication device 1 serves as an initiator. Therefore, although the communicate mode is the passive mode and the signal which the encoding section 16 outputs is supplied to the load modulation section 20 through the selection section 17 in the case where the NFC communication device 1 serves as a target, it is supplied to the modulation section 19 through the selection section 17 in other cases.

[0049]

The electromagnetic wave output section 18 passes the current for making the subcarrier (electromagnetic wave) of a single predetermined frequency emit from an antenna 11 at an antenna 11. The electromagnetic wave output section 18 modulates the modulation section 19 according to the signal to which the subcarrier as a current passed at an antenna 11 is supplied from the selection section 17. Thereby, from an antenna 11, the electromagnetic wave on which the data-processing section 15 modulated the subcarrier according to the data outputted to the encoding section 16 is emitted.

[0050]

The load modulation section 20 changes the impedance when seeing the coil as an antenna 11 from the exterior according to the signal supplied from the selection section 17. When other equipments output the electromagnetic wave as a subcarrier, RF field (field) is formed in the perimeter of an antenna 11, and the impedance when seeing the coil as an antenna 11 changes, RF field around an antenna 11 also changes. The subcarrier as an electromagnetic wave which other equipments are outputting is modulated by this according to the signal supplied from the selection section 17, and the data which the data-processing section 15 outputted to the encoding section 16 are transmitted to other equipments which are outputting the electromagnetic wave.

[0051]

Here, as a modulation technique in the modulation section 19 and the load modulation section 20, amplitude modulation (ASK (Amplitude Shift Keying)) is employable, for example. However, it is not limited to ASK and the modulation technique in the modulation section 19 and the load modulation section 20 can adopt PSK (Phase Shift Keying), and QAM (Quadrature Amplitude Modulation) and others. Moreover, what is necessary is not to be limited to numeric values, such as 8% to 30%, 50%, and 100 etc.%, about the modulation factor of the amplitude, and just to choose a suitable thing.

[0052]

A control section 21 controls each block which constitutes the NFC communication device 1. A power supply section 22 supplies a power source required for each block which constitutes the NFC communication device 1. In addition, since drawing

becomes complicated, the illustration showing controlling each block whose control section 21 constitutes the NFC communication device 1 by drawing 4 of a line, and illustration of the line by which a power supply section 22 means supplying a power source in each block which constitutes the NFC communication device 1 have been omitted.

[0053]

A detecting element 23 detects whether the current which flows at an antenna 11 is received like a receive section 12, and the electromagnetic wave of the level beyond the predetermined threshold supplied from the threshold setting section 24 (flux density) is received by the antenna 11 based on the current.

[0054]

The threshold setting section 24 sets up the threshold of the level of the electromagnetic wave which a detecting element 23 is made to detect, and supplies it to a detecting element 23. In addition, the threshold setting section 24 can set up now two thresholds (the subcarrier output control decision flux density TH1 mentioned later and operating-limits subcarrier flux density TH2), and a detecting element 23 detects the electromagnetic wave of the level beyond the threshold which the threshold setting section 24 of the two thresholds sets up. However, the NFC communication device 1 prepares and constitutes a detecting element 25 further, makes a detecting element 23 detect the electromagnetic wave of the level beyond one threshold of the two thresholds, and can make a detecting element 25 detect the electromagnetic wave of the level beyond the threshold of another side, as the dotted line other than a detecting element 23 shows drawing 4 .

[0055]

In the above-mentioned case, in the decoding section 14 and the encoding section 16, the Manchester code adopted by the above-mentioned type C was processed here, but in the decoding section 14 and the encoding section 16, process is able to choose one from two or more kinds of signs, such as not only a Manchester code but modification DOMIRA adopted by Type A, NRZ adopted by Type C, and to make it.

[0056]

Next, drawing 5 shows the example of a configuration of the recovery section 13 of drawing 4 .

[0057]

At drawing 5 , the recovery section 13 consists of the recovery section 321 of N individual which are the 31 or 2 or more selection sections thru/or 32 Ns, and the selection section 33.

[0058]

According to control of a control section 21 (drawing 4), while being the recovery section 321 of N individual thru/or 32Ns, from from, the selection section 31 chooses 32n (n= 1, 2, ..., N) of one recovery section, and supplies the signal which a receive section 12 outputs to 32n of the selected recovery section.

[0059]

32n of recovery sections restores to the signal transmitted at the n-th transmission rate, and they supply it to the selection section 33. Here, 32n of recovery sections and 32n [of recovery sections]' (n!=n') restore to the signal transmitted at a different transmission rate. Therefore, the recovery section 13 of drawing 5 can restore now to the signal transmitted at the transmission rate as N of the 1st thru/or ** a Nth. In addition, as a transmission rate as N, more nearly high-speed 424kbps(es) besides 106kbps(es) mentioned above and 212kbps, 848kbps, etc. are employable, for example. That is, the transmission rate already adopted in the contiguity communication link of the existing IC card system etc. and the other transmission rate can be included in the transmission rate as N.

[0060]

According to control of a control section 21, while being the recovery section 321 of N individual thru/or 32Ns, from from, the selection section 33 chooses 32n of one recovery section, and supplies the recovery output obtained in 32n of the recovery section to the decoding section 14.

[0061]

A control section 21 (drawing 4) makes the selection section 31 make sequential selection of the recovery section 321 of N individual thru/or the 32 Ns, and, thereby, makes it recover the recovery section 321 thru/or 32Ns of signals supplied through the selection section 31 from a receive section 12 to each in the recovery section 13 constituted as mentioned above. And a control section 21 recognizes 32n of recovery sections which were able to recover normally the signal supplied through the selection section 31 from the receive section 12, and controls the selection section 33 to choose the output of 32n of the recovery section. The selection section 33 chooses 32n of recovery sections according to control of a control section 21, and, thereby, the normal recovery output obtained in 32n of recovery sections is supplied to the decoding section 14.

[0062]

Therefore, in the recovery section 13, it can restore to the signal transmitted at the transmission rate of the arbitration of the transmission rates as N.

[0063]
In addition, only when it is able to get over normally, a recovery output is outputted, nothing is outputted, it can twist (for example, it becomes high impedance), and the recovery section 321 thru/or 32 Ns can be made like, when it is not able to get over normally. In this case, the selection section 33 takes the recovery section 321 thru/or an OR with an outputs [all] of 32 Ns, and should just output it to the decoding section 14.
[0064]
Next, drawing 6 shows the example of a configuration of the modulation section 19 of drawing 4 .
[0065]
At drawing 6 , the modulation section 19 consists of the modulation section 421 of N individual which are the 41 or 2 or more selection sections thru/or 42 Ns, and the selection section 43.
[0066]
According to control of a control section 21 (drawing 4), while being the modulation section 421 of N individual thru/or 42Ns, from from, the selection section 41 chooses 42n (n= 1, 2, ..., N) of one modulation section, and supplies the signal which the selection section 17 (drawing 4) outputs to 42n of the selected modulation section.
[0067]
42n of modulation sections is modulated through the selection section 43 according to the signal to which the subcarrier as a current which flows at an antenna 11 is supplied from the selection section 41 so that transmission of data may be performed at the n-th transmission rate. Here, 42n of modulation sections and 42n [of modulation sections]' (n!=n') modulate a subcarrier at a different transmission rate. Therefore, the modulation section 19 of drawing 6 can transmit data now at the transmission rate as N of the 1st thru/or ** a Nth. In addition, as a transmission rate as N, the same transmission rate as the ability to restore to the recovery section 13 of drawing 5 is employable, for example.
[0068]
According to control of a control section 21, while being the modulation section 421 of N individual thru/or 42Ns, from from, the selection section 43 chooses the 42n of the same modulation sections as the selection section 41 choosing, and connects electrically 42n of the modulation section, and an antenna 11.
[0069]
A control section 21 (drawing 4) makes the selection section 41 make sequential selection of the modulation section 421 of N individual thru/or the 42 Ns, and, thereby, makes it modulate 42Ns of subcarriers as a current which flow at an antenna 11 through the selection section 43 in the modulation section 19 constituted as mentioned above according to the modulation section 421 thru/or the signal supplied to each from the selection section 41.
[0070]
Therefore, in the modulation section 19, a subcarrier can be modulated and data can be transmitted so that data may be transmitted at the transmission rate of the arbitration of the transmission rates as N.
[0071]
In addition, since it is constituted like the modulation section 19 of drawing 6 , the load modulation section 20 of drawing 4 omits the explanation.
[0072]
As mentioned above, in the NFC communication device 1 thru/or 3, while modulating a subcarrier to the signal of the data to which it is transmitted at the transmission rate of either of the transmission rates as N, it can restore to the signal of the data transmitted at the transmission rate of either of the transmission rates as N. And as mentioned above, the transmission rate already adopted in the contiguity communication link of the existing IC card systems (FeliCa method etc.) etc. and the other transmission rate can be included in the transmission rate as N, for example. Therefore, according to the NFC communication device 1 thru/or 3, between each, data can be exchanged at any transmission rate of the transmission rate as the N. Furthermore, according to the NFC communication device 1 thru/or 3, data can be exchanged at the transmission rate which the IC card and reader/writer have adopted also between the IC cards and reader/writers which constitute the existing IC card system.
[0073]
And even if it, as a result, introduces the NFC communication device 1 thru/or 3 into the service as which the existing contiguity communication link is adopted, a user cannot do derangement etc., therefore the installation can be performed easily. Furthermore, the NFC communication device 1 thru/or 3 can be easily introduced also into the service as which the contiguity communication link by the high-speed data rate it is expected to be to appear in the future is adopted, aiming at coexistence with the existing contiguity communication link.
[0074]
Moreover, in the NFC communication device 1 thru/or 3, since the data transmission

in the active mode in which data are transmitted when self besides the passive mode adopted by the conventional contiguity communication link outputs an electromagnetic wave is possible, even if it does not mind other equipments, such as reader/writer, data can be exchanged directly.

[0075]

Next, drawing 7 shows other examples of a configuration of the recovery section 13 of drawing 4 . In addition, about the case in drawing 5 , and the corresponding part, the same sign is attached among drawing, and, below, the explanation is omitted suitably. That is, the recovery section 13 of drawing 7 is fundamentally constituted similarly with the case [the selection section 31 is not formed and also] in drawing 5 .

[0076]

That is, to the recovery section 321 thru/or 32 Ns, the signal which a receive section 12 outputs with the gestalt of operation of drawing 7 is supplied to coincidence, and the signal from a receive section 12 restores to it by the recovery section 321 thru/or 32Ns at coincidence. And a control section 21 recognizes 32n of recovery sections which were able to restore to the signal from a receive section 12 normally, and controls the selection section 33 to output 32n of the recovery section. The selection section 33 chooses 32n of recovery sections according to control of a control section 21, and, thereby, the normal recovery output obtained in 32n of recovery sections is supplied to the decoding section 14.

[0077]

In addition, it is necessary to make recovery actuation always perform to the recovery section 321 thru/or 32 Ns with the gestalt of operation of drawing 7 . On the other hand, with the gestalt of operation of drawing 5 , recovery actuation can be made to be able to perform only to what is chosen as the selection section 31 the recovery section 321 thru/or of the 32 Ns, and other things can stop actuation. Therefore, from a viewpoint which saves the power consumption of equipment, the configuration of drawing 5 is more advantageous than drawing 7 . From a viewpoint which obtains a normal recovery output at an early stage on the other hand, the configuration of drawing 7 is more advantageous than drawing 5 .

[0078]

Next, drawing 8 shows the example of a configuration of further others of the recovery section 13 of drawing 4 .

[0079]

At drawing 8 , the recovery section 13 consists of the adjustable rate recovery section 51 and a rate detecting element 52.

[0080]

The adjustable rate recovery section 51 restores to the signal supplied from a receive section 12 as a signal of the transmission rate according to the directions from the rate detecting element 52, and supplies the recovery result to the decoding section 14. The rate detecting element 52 detects the transmission rate of the signal supplied from a receive section 12, and it directs it in the adjustable rate recovery section 51 so that it may restore to the signal of the transmission rate.

[0081]

In the recovery section 51 constituted as mentioned above, the signal which a receive section 12 outputs is supplied to the adjustable rate recovery section 51 and the rate detecting element 52. The rate detecting element 52 is directed in the adjustable rate recovery section 51 so that the transmission rate of the signal supplied from a receive section 12 may detect any of the transmission rates as N of the 1st thru/or ** a Nth they are and may restore to the signal of the transmission rate. And the adjustable rate recovery section 51 restores to the signal supplied from a receive section 12 as a signal of the transmission rate according to the directions from the rate detecting element 52, and supplies the recovery result to the decoding section 14.

[0082]

Next, each of NFC communication device 1 thru/or 3 can become the initiator which outputs an electromagnetic wave first and starts a communication link. Furthermore, in the active mode, the NFC communication device 1 thru/or 3 output an electromagnetic wave in person, when becoming an initiator, or when becoming a target.

[0083]

When two or more [of them] output an electromagnetic wave to coincidence, it becomes impossible therefore, to communicate by collision (collision) arising in the condition that the NFC communication device 1 thru/or 3 are close.

[0084]

the NFC communication device 1 thru/or 3 -- only when it does not detect and exist [whether the electromagnetic wave (RF field to depend) from other equipments exists, and], each starts the output of an electromagnetic wave and, thereby, prevents collision. [then,] Here, in this way, only when it does not detect and exist [whether the electromagnetic wave from other equipments exists, and], the processing which starts the output of an electromagnetic wave is called RFCA (RF Collision Avoidance) processing from the purpose of preventing collision.

[0085]

There are two, the initial RFCA processing which the NFC communication device (the NFC communication device 1 thru/or 1 or more [Drawing 1 / of 3]) which is going to serve as an initiator performs first, and the response RFCA processing performed whenever the NFC communication device which starts the output of an electromagnetic wave during a communication link with the active mode tends to carry out the initiation, in RFCA processing. Only when it does not detect and exist [whether the electromagnetic wave by other equipments exists, and] before starting the output of an electromagnetic wave even if it is initial RFCA processing and is response RFCA processing, the point of starting the output of an electromagnetic wave is the same. However, by initial RFCA processing and response RFCA processing, since existence of the electromagnetic wave by other equipments is no longer detected, the time amount to the timing which must start the output of an electromagnetic wave etc. differs.

[0086]

Then, with reference to drawing 9 , initial RFCA processing is explained first.

[0087]

Drawing 9 shows the electromagnetic wave by which an output is started by initial RFCA processing. In addition, in drawing 9 (the same is said of drawing 10 mentioned later), an axis of abscissa expresses time amount and an axis of ordinate expresses the level of the electromagnetic wave which a NFC communication device outputs.

[0088]

The NFC communication device which is going to serve as an initiator is detecting the electromagnetic wave by other equipments, and after only the output to the time amount TIRFG passes [the electromagnetic wave by other equipments] by starting the output of an electromagnetic wave when only time amount TIDT+nxTRFW is not detected continuously, it always starts transmission (Send Request) of data (a command is included).

[0089]

Here, TIDT in time amount TIDT+nxTRFW is called initial delay time amount, and if it is expressing the frequency of a subcarrier with fc, an adult value will be adopted from 4096/fc, for example. n is or more 0 three or less integer, and is generated using a random number. TRFW is called RF latency time, for example, 512/fc is adopted. Time amount TIRFG is called an initial guard time, for example, an adult value is adopted from 5ms.

[0090]

In addition, reduction of possibility of starting the output of an electromagnetic wave is achieved to the timing that two or more NFC communication devices are the same, by adopting n which is a random number as time amount TIDT+nxTRFW by which an electromagnetic wave must not be detected.

[0091]

When a NFC communication device starts the output of an electromagnetic wave by initial RFCA processing, the NFC communication device serves as an initiator, but when the active mode is set up as the communicate mode at that time, the NFC communication device used as an initiator suspends the output of an electromagnetic wave, after ending transmission of own data. On the other hand, as the communicate mode, when the passive mode is set up, the NFC communication device used as an initiator continues the output of the electromagnetic wave started by initial RFCA processing as it is until the communication link with a target is completed completely.

[0092]

Next, drawing 10 shows the electromagnetic wave by which an output is started by response RFCA processing.

[0093]

The NFC communication device which is going to output an electromagnetic wave in the active mode detects the electromagnetic wave by other equipments, and after only the output to the time amount TARFG passes [the electromagnetic wave by other equipments] by starting the output of an electromagnetic wave when only time amount TADT+nxTRFW is not detected continuously, it starts transmission (Send Responsese) of data.

[0094]

Here, n and TRFW in time amount TADT+nxTRFW are the same as that of the case in initial RFCA processing of drawing 9 . Moreover, TADT in time amount TADT+nxTRFW is called an active delay time, for example, the value below 2559-/fc is adopted more than 768-/fc. Time amount TARFG is called an active guard time, for example, an adult value is adopted from 1024/fc.

[0095]

In order to start the output of an electromagnetic wave by initial RFCA processing so that clearly from drawing 9 and drawing 10 , an electromagnetic wave must not exist between the initial delay time amount TIDT at least, and in order to start the output of an electromagnetic wave by response RFCA processing, an electromagnetic wave must not exist between the active delay times TADT at least.

[0096]

And the condition that an electromagnetic wave does not exist rather than the case

where it is going to output an electromagnetic wave during a communication link with the active mode from the initial delay time amount4096/fc when a NFC communication device tends to become an initiator, since the active delay time TADT is a value below 2559-/fc more than 768-/fc to TIDT being an adult value is the long duration need. Conversely, if it says, when a NFC communication device tends to output an electromagnetic wave during a communication link with the active mode, after being in the condition that an electromagnetic wave does not exist from the case where it is going to become an initiator, an electromagnetic wave must be outputted so much for between to a dish. This is based on the following reasons.

[0097]

That is, when a NFC communication device communicates in the active mode, one NFC communication device outputs an electromagnetic wave in person, transmits data, and suspends the output of an electromagnetic wave after that. And the NFC communication device of another side starts the output of an electromagnetic wave, and data are transmitted. Therefore, in the communication link in the active mode, any NFC communication device may have suspended the output of an electromagnetic wave. for this reason, when a NFC communication device tends to become an initiator, in order to check that the communication link in the active mode is not performed around that NFC communication device, the perimeter of the NFC communication device which is going to become an initiator is enough in other equipments not outputting the electromagnetic wave -- it is necessary to carry out a time amount check

[0098]

On the other hand, in the active mode, as mentioned above, when an initiator outputs an electromagnetic wave, data are transmitted to a target. And a target transmits data to an initiator by starting the output of an electromagnetic wave, after an initiator suspends the output of an electromagnetic wave. Then, after, as for an initiator, a target suspends the output of an electromagnetic wave, by starting the output of an electromagnetic wave, data are transmitted to an initiator and data are hereafter exchanged between an initiator and a target similarly.

[0099]

Therefore, around the initiator which is communicating the active mode, and a target When the NFC communication device which is going to serve as an initiator exists, after one side of the initiators and targets which are communicating the active mode suspends the output of an electromagnetic wave If time amount until another side starts the output of an electromagnetic wave is long, since an electromagnetic wave does not exist in the meantime, the NFC communication device which is going to serve as an initiator starts the output of an electromagnetic wave by initial RFCA processing. In this case, the communication link in the active mode currently performed previously will be barred.

[0100]

For this reason, after being in the condition that an electromagnetic wave does not exist, he is trying to have to output an electromagnetic wave for between to a dish so much in the response RFCA processing performed during the communication link in the active mode.

[0101]

Next, as drawing 9 explained, by initial RFCA processing, the NFC communication device which is going to become an initiator starts the output of an electromagnetic wave, and performs transmission of data after that. Although the NFC communication device which is going to become an initiator is starting the output of an electromagnetic wave, and serves as an initiator and the NFC communication device which exists in the location close to the initiator serves as a target, an initiator must specify the target which exchanges the data, in order to carry out an exchange of a target and data. For this reason, an initiator requires NFCID (NFC Identification) as information which specifies each target from one or more targets which exist in the location close to that initiator, after starting the output of an electromagnetic wave by initial RFCA processing. And the target which exists in the location close to an initiator transmits NFCID which specifies self to an initiator according to the demand from an initiator.

[0102]

Although an initiator specifies a target and exchanges data between the specified target by NFCID transmitted from a target as mentioned above, the processing whose initiator specifies the target which exists in the perimeter (approaching location) by the NFCID is called SDD (Single Device Detection) processing.

[0103]

Here, in SDD processing, although an initiator requires NFCID of a target, this demand is performed, when an initiator transmits the frame called a polling request frame. If a polling request frame is received, a target will determine own NFCID with a random number, and will transmit the frame called the polling response frame which has arranged the NFCID, for example. An initiator is receiving the polling response frame transmitted from a target, and recognizes NFCID of a target.

[0104]

By the way, when an initiator requires the NFCID from the target of the perimeter and two or more targets exist in the perimeter of an initiator, NFCID may be transmitted to 2, as mentioned above coincidence of two or more of the targets. In this case, NFCID transmitted from those two or more targets cannot carry out collision, and an initiator cannot recognize that NFCID that carried out collision.

[0105]

Then, SDD processing is performed by the approach using a time slot in order to avoid the collision of NFCID if possible.

[0106]

That is, drawing 11 shows the sequence of the SDD processing performed by the approach which used the time slot. In addition, in drawing 11 , five target #1, #2, #3, #4, and #5 shall have existed in the perimeter of an initiator.

[0107]

In SDD processing, although an initiator transmits a polling request frame, only the predetermined time amount Td is set after completion of the transmission, and the time slot of the width of face of the predetermined time amount Ts is prepared. In addition, time amount Td is set to 512x64/fc, and time amount Ts as width of face of a time slot is set to 256x64/fc. Moreover, a time slot is specified by giving the sequential number (integer) from [from what is preceded most] 0 to for example, a time amount target.

[0108]

Although four, time-slot #0, #1, #2, and #3, are shown, a time slot can be prepared to 16 here at drawing 11 . An initiator specifies the number TSN of the time slots prepared to a certain polling request frame, it is included in a polling request frame, and is transmitted to a target.

[0109]

A target receives the polling request frame transmitted from an initiator, and recognizes the number TSN of the time slots arranged at the polling request frame. Furthermore, a target generates the integer R of the range of more than 0TSN-1 with a random number, is the timing of time-slot #R specified for the integer R, and transmits the polling response frame which has arranged own NFCID.

[0110]

As mentioned above, since a target determines the time slot as timing which transmits a polling response frame with a random number, the timing to which two or more targets transmit a polling response frame will vary, and, thereby, if possible, it can avoid the collision of the polling response frames which two or more targets transmit.

[0111]

In addition, in a target, even if a random number determines the time slot as timing which transmits a polling response frame, the time slot to which two or more targets transmit a polling response frame may be in agreement, and, thereby, the collision of a polling response frame may arise. In time-slot #0, in time-slot #1, the polling response frame of target #2 is transmitted [in / in the polling response frame of target #1 and #3 / time-slot #3] for the polling response frame of target #5, respectively, and the polling response frame of target #1 and #3 has produced [in / in the polling response frame of target #4 / time-slot #2] collision with the gestalt of operation of drawing 11 .

[0112]

In this case, an initiator cannot receive normally the polling response frame of target #1 and #3 which has produced collision. Therefore, again, an initiator transmits a polling request frame and, thereby, requires transmission of the polling response frame by which each NFCID has been arranged from target #1 and #3. target #1 which is in the perimeter in an initiator hereafter thru/or #5 — transmission of the polling request frame by the initiator and transmission of the polling response frame by the target are repeatedly performed until it can recognize all NFCID(s).

[0113]

In addition, when an initiator transmits a polling request frame again, if [all target #1 thru/or #5] a polling response frame is returned, polling response frames may start collision again. Then, in a target, when a polling request frame is again received so much for time amount as a dish after receiving a polling request frame from an initiator, the polling request can be disregarded, for example. However, since an initiator cannot recognize that NFCID of target #1 and #3 about target #1 which has produced the collision of a polling response to the polling request frame transmitted first with the gestalt of operation of drawing 11 in this case, and #3, an exchange of the data between target #1 or #3 can be performed.

[0114]

Then, a polling response frame is received normally, and an initiator removes temporarily from the candidate for a communication link, and can be prevented from returning the polling response frame as a response to a polling request frame by this about target #2 which have recognized the NFCID, #4, and #5, so that it may mention later. In this case, returning a polling response frame is set only to target #1 which has not recognized NFCID by transmission of the first polling request frame, and #3 to the polling request frame for the second time which an initiator transmits. therefore —

while making small possibility that polling response frames will start collision in this case — target #1 thru/or #5 — it becomes possible to recognize all NFCID(s).

[0115]

Moreover, a target will determine own NFCID with a random number here, if a polling request frame is received as mentioned above (generation). For this reason, from a different target, the same NFCID is arranged at a polling response frame, and may be transmitted to an initiator. When the polling response frame by which the same NFCID has been arranged is received, a polling request frame can be made to transmit to an initiator again like the case where for example, polling response frames start collision, in a different time slot in an initiator.

[0116]

Here, as mentioned above, also between the IC cards and reader/writers which constitute the existing IC card system, a NFC communication device is the transmission rate which the IC card and reader/writer have adopted, and can exchange data. Now, when a target is the IC card of the existing IC card system, SDD processing is performed as follows, for example.

[0117]

That is, the IC card an initiator starts the output of an electromagnetic wave by initial RFCA processing, and is [IC card] a target acquires a power source from the electromagnetic wave, and starts processing. That is, since a target is the IC card of the existing IC card system in now, the power source for operating is generated from the electromagnetic wave which an initiator outputs.

[0118]

After a target acquires a power source and is in the condition that it can operate, the preparations with which the longest also receives a polling request frame within 2 seconds are made, and it waits to transmit a polling request frame from an initiator, for example.

[0119]

On the other hand, an initiator can transmit a polling request frame regardless of whether the preparation which receives a polling request frame in a target was completed.

[0120]

When the polling request frame from an initiator is received, as mentioned above, a target is the timing of a predetermined time slot and transmits a polling response frame to an initiator. When normal reception of the polling response frame from a target is able to be carried out, an initiator recognizes NFCID of the target, as mentioned above. On the other hand, an initiator can transmit a polling request frame again, when normal reception of the polling response frame from a target is not able to be carried out.

[0121]

In addition, since a target is the IC card of the existing IC card system in now, the power source for operating is generated from the electromagnetic wave which an initiator outputs. For this reason, an initiator continues until the communication link with a target ends completely the output of the electromagnetic wave started by initial RFCA processing.

[0122]

Next, a communication link is performed by the NFC communication device by what (it returns) an initiator transmits a command to a target and a target transmits the response to the command from an initiator for.

[0123]

Then, drawing 12 shows the command which an initiator transmits to a target, and the response which a target transmits to an initiator.

[0124]

In drawing 12 , that the alphabetic character of REQ is described to be after the underbar (_) expresses a command, and that the alphabetic character of RES is described to be after the underbar (_) expresses a response. With the gestalt of operation of drawing 12 , as a command, six kinds, ATR_REQ, WUP_REQ, PSL_REQ, DEP_REQ, DSL_REQ, and RLS_REQ, are prepared, and six kinds, ATR_RES, WUP_RES, PSL_RES, DEP_RES, DSL_RES, and RLS_RES, are prepared like the command also as a response to a command. Since an initiator transmits a command (request) to a target and a target transmits the response corresponding to the command to an initiator as mentioned above, a command is transmitted by the initiator and a response is transmitted with a target.

[0125]

Command ATR_REQ is transmitted to a target, when requiring the attribute of a target, while an initiator tells an own attribute (specification) to a target. Here, as an attribute of an initiator or a target, there is a transmission rate of the data which can transmit and receive the initiator or target etc. In addition, to command ATR_REQ, NFCID which specifies its initiator besides the attribute of an initiator is arranged, and a target recognizes the attribute and NFCID of an initiator by receiving command ATR_REQ.

[0126]

Response ATR_REQ is transmitted to an initiator as a response to the command ATR_REQ, when a target receives command ATR_REQ. An attribute, NFCID, etc. of a target are arranged at response ATR_REQ.
[0127]
In addition, all the transmission rates of the data which can transmit and receive an initiator and a target can be included in the information on the transmission rate as an attribute arranged at command ATR_REQ or response ATR_REQ. In this case, between an initiator and a target, only by the exchange of command ATR_REQ and response ATR_REQ being performed once, the transmission rate which can transmit and receive a target can be recognized and, as for an initiator, a target can also recognize the transmission rate which can transmit and receive an initiator.
[0128]
Command WUP_REQ is transmitted when an initiator chooses the target which communicates. That is, although a target can be made into a DISEREKUTO (deselect) condition (condition which forbade transmission (response) of the data to an initiator) by transmitting command DSL_REQ mentioned later to a target from an initiator, command WUP_REQ dispels the DISEREKUTO condition, and when making a target into the condition of enabling transmission of the data to an initiator, it is transmitted. In addition, the target specified as command WUP_REQ by NFCID which NFCID of a target which dispels a DISEREKUTO condition is arranged and is arranged at the command WUP_REQ among the targets which received command WUP_REQ dispels a DISEREKUTO condition.
[0129]
Response WUP_RES is transmitted as a response to command WUP_REQ, when the target specified by NFCID arranged at the command WUP_REQ among the targets which received command WUP_REQ dispels a DISEREKUTO condition.
[0130]
Command PSL_REQ is transmitted when an initiator changes the communications parameter about the communication link with a target. Here, as a communications parameter, there is a transmission rate of the data exchanged between an initiator and a target etc., for example.
[0131]
The value of the communications parameter after modification is arranged at command PSL_REQ, and it is transmitted to a target from an initiator. A target receives command PSL_REQ and changes a communications parameter according to the value of the communications parameter arranged there. Furthermore, a target transmits response PSL_RES to command PSL_REQ.
[0132]
The data which command DEP_REQ is transmitted when an initiator transmits and receives data (the so-called live data) (data exchange between targets), and should be transmitted to a target there are arranged. The data which a target should transmit response DEP_RES as a response to command DEP_REQ, and should be transmitted there at an initiator are arranged. Therefore, data are transmitted to a target by command DEP_REQ from an initiator, and data are transmitted to an initiator from a target by response DEP_RES to the command DEP_REQ.
[0133]
Command DSL_REQ is transmitted when an initiator makes a target a DISEREKUTO condition. The target which received command DSL_REQ will transmit response DSL_RES to the command DSL_REQ, will be in a DISEREKUTO condition, and will not react to any commands other than command WUP_REQ henceforth (it stops returning a response).
[0134]
Command RLS_REQ is transmitted when an initiator ends the communication link with a target completely. The target which received command RLS_REQ transmits response RLS_RES to the command RLS_REQ, and ends the communication link with an initiator completely.
[0135]
Here, each of command DSL_REQ and RLS_REQ is common in that a target is released from the object of the communication link with an initiator. However, although the target released by command DSL_REQ will be in an initiator and the condition which can be communicated again by command WUP_REQ, the target released by command RLS_REQ will not be in an initiator and the condition which can be communicated, unless the exchange of the polling request frame mentioned above and a polling response frame is performed between initiators. At this point, command DSL_REQ differs from RLS_REQ.
[0136]
In addition, the exchange of a command and a response can be performed by the transport layer.
[0137]
Next, the communications processing of a NFC communication device is explained with reference to the flow chart of drawing 13 .
[0138]

A NFC communication device judges first whether the electromagnetic wave by other equipments was detected in step S1, when starting a communication link.

[0139]

Here, in a NFC communication device (drawing 4), the control section 21 is supervising the detection result of the electromagnetic wave (the electromagnetic wave used with a NFC communication device, and electromagnetic wave with the same frequency band etc.) in a detecting element 23, and it is judged at step S1 based on the detection result whether the electromagnetic wave by other equipments was detected. Namely, in this case, the threshold setting section 24 of drawing 4 sets up as a threshold the subcarrier output control decision flux density TH1 explained by drawing 24 thru/or drawing 26 mentioned later, and supplies it to a detecting element 23. And a detecting element 23 detects with a subcarrier output control decision flux density [as a threshold supplied from the threshold setting section 24 / TH] of one or more level.

[0140]

In step S1, when judged with the electromagnetic wave by other equipments not having been detected, it progresses to step S2 and a NFC communication device processes processing of the initiator in the passive mode which sets the communicate mode as the passive mode or the active mode, and mentions it later, or the initiator in the active mode. And a NFC communication device repeats the same processing return and the following to step S1 after termination of the processing.

[0141]

Here, in step S2, the communicate mode of a NFC communication device may be set as any of the passive mode or the active modes, as mentioned above. However, when a target cannot turn into only a target in the passive modes, such as an IC card of the existing IC card system, at step S2, a NFC communication device needs to set the communicate mode as the passive mode, and needs to process the initiator in the passive mode.

[0142]

When it is judged with the electromagnetic wave by other equipments having been detected in step S1 on the other hand (i.e., when the electromagnetic wave by other equipments is detected around a NFC communication device), it progresses to step S3 and a NFC communication device judges whether the electromagnetic wave detected at step S1 is continue being detected.

[0143]

In step S3, when judged with an electromagnetic wave continuing being detected, it progresses to step S4 and a NFC communication device processes the target in the passive mode which sets the communicate mode as the passive mode, and mentions it later. Namely, it is the case which is continuing outputting the electromagnetic wave which started the output by initial RFCA processing by becoming the initiator in the passive mode, and a NFC communication device processes by other equipments with which the case where an electromagnetic wave is continuing being detected approaches for example, a NFC communication device serving as a target in the passive mode. And the same processing is repeated by step S1 return and the following after termination of the processing.

[0144]

Moreover, in step S3, when judged with an electromagnetic wave continuing being detected, it progresses to step S5 and a NFC communication device processes the target in the active mode which sets the communicate mode as the active mode, and mentions it later. That is, since other equipments with which the case where an electromagnetic wave is continuing being detected approaches for example, a NFC communication device are the cases which started the output of an electromagnetic wave by initial RFCA processing by becoming the initiator in the active mode, and suspended the output of the electromagnetic wave after that, they serve as a target in the active mode, and a NFC communication device processes. And the same processing is repeated by step S1 return and the following after termination of the processing.

[0145]

Next, with reference to the flow chart of drawing 14 , processing of the initiator in the passive mode by the NFC communication device is explained.

[0146]

In processing of the initiator in the passive mode, a NFC communication device starts the output of an electromagnetic wave in step S11 first. In addition, in step S1 of above-mentioned drawing 13 , step S11 in processing of the initiator in this passive mode is performed, when an electromagnetic wave is not detected. That is, in step S1 of drawing 13 , a NFC communication device starts the output of an electromagnetic wave in step S11, when an electromagnetic wave is not detected. Therefore, processing of steps S1 and S11 is equivalent to above-mentioned initial RFCA processing.

[0147]

Then, it progresses to step S12, and a NFC communication device sets the variable n showing a transmission rate to 1 as initial value, and progresses to step S13. At step

S13, a NFC communication device is the n-th transmission rate (suitably henceforth the n-th rate), transmits a polling request frame and progresses to step S14. At step S14, from other equipments, a NFC communication device is the n-th rate, and judges whether the polling response frame has been transmitted.

[0148]

In step S14, other equipments which approach for example, a NFC communication device when judged [that a polling response frame has not been transmitted and] from other equipments cannot perform a communication link at the n-th rate, but when the polling response frame to the polling request frame transmitted at the n-th rate does not come on the contrary, step S15 thru/or S17 are skipped, and it progresses to step S18.

[0149]

Moreover, when it is judged with the polling response frame having been transmitted at the n-th rate from other equipments in step S14, Namely, for example, other equipments close to a NFC communication device can perform a communication link at the n-th rate. When the polling response frame to the polling request frame transmitted at the n-th rate comes on the contrary, it progresses to step S15. A NFC communication device As a target in the passive mode, while recognizing other equipments which have returned the polling response frame by NFCID arranged in NFCID of the target at the polling response frame It recognizes that the target can communicate at the n-th rate.

[0150]

Here, if a NFC communication device recognizes that the target can communicate with NFCID of the target in the passive mode at the n-th rate in step S15, the transmission rate between the target is determined as the n-th rate (temporarily), and the target will communicate at the n-th rate, unless a transmission rate is changed by command PSL_REQ.

[0151]

Then, it progresses to step S16, and a NFC communication device transmits command DSL_REQ to the target (target in the passive mode) of NFCID recognized at step S15 at the n-th rate, thereby, it is changed into a DISEREKUTO condition and progresses to step S17 so that the target may not answer the polling request frame transmitted henceforth.

[0152]

At step S17, a NFC communication device receives response DSL_RES which the target made a DISEREKUTO condition by the command DSL_REQ returns to command DSL_REQ which transmitted at step S16, and progresses to step S18.

[0153]

In step S18, at step S13, a NFC communication device judges whether predetermined time amount passed, after transmitting a polling request frame at the n-th rate. Here, predetermined time amount in step S18 can be made into zero or more time amount.

[0154]

In step S18, after transmitting a polling request frame at the n-th rate by step S13, when it is still judged with predetermined time amount having not passed, step S13 thru/or processing of S18 are repeated by step S13 return and the following.

[0155]

Here, by repeating step S13 thru/or processing of S18, a NFC communication device can receive the polling response frame transmitted to the timing of a different time slot, as drawing 11 explained.

[0156]

On the other hand, after transmitting a polling request frame at the n-th rate by step S13, when it is judged with predetermined time amount having passed in step S18, it progresses to step S19 and judges whether a NFC communication device is equal to N whose variable n is the maximum. In step S19, when it judges that Variable n is not equal to Maximum N (i.e., when Variable n is under the maximum N), it progresses to step S20, and only 1 increments Variable n and, as for a NFC communication device, step S13 thru/or processing of S20 are repeated by step S13 return and the following in it.

[0157]

Here, while a NFC communication device is a transmission rate as N by repeating step S13 thru/or processing of S20 and transmitting a polling request frame, the polling response frame which comes by each transmission rate on the contrary is received.

[0158]

On the other hand, when it judges that Variable n is equal to Maximum N in step S19 (i.e., while transmitting a polling request frame, when a NFC communication device receives the polling response frame which comes by each transmission rate on the contrary at the transmission rate as N as N), it progresses to step S21 and, as for a NFC communication device, the communications processing (communications processing of the initiator in the passive mode) is performed as an initiator in the passive mode. Here, about the communications processing of the initiator in the passive mode, it mentions later.

[0159]

And after the communications processing of the initiator in the passive mode is completed, a NFC communication device progresses to S22 from step S21, suspends the output of the electromagnetic wave which started the output at step S11, and ends processing.
[0160]
Next, with reference to the flow chart of drawing 15 , processing of the target in the passive mode by the NFC communication device is explained.
[0161]
In processing of the target in the passive mode, first, in step S31, a NFC communication device sets the variable n showing a transmission rate to 1 as initial value, and progresses to step S32. At step S32, from other equipments used as the initiator in the passive mode, a NFC communication device is the n-th rate, and judges whether the polling request frame has been transmitted.
[0162]
In step S32, when judged [that a polling request frame has not been transmitted and] from the initiator in the passive mode (i.e., when other equipments close to for example, a NFC communication device cannot perform a communication link at the n-th rate and cannot transmit a polling request frame at the n-th rate), it progresses to step S33 and judges whether a NFC communication device is equal to N whose variable n is the maximum. In step S33, when it judges that Variable n is not equal to Maximum N (i.e., when Variable n is under the maximum N), it progresses to step S34, and only 1 increments Variable n and, as for a NFC communication device, step S32 thru/or processing of S34 are repeated by step S32 return and the following in it.
[0163]
Moreover, in step S33, when it judges that Variable n is equal to Maximum N, step S31 thru/or processing of S34 are repeated by step S31 return and the following. That is, step S31 thru/or processing of S34 are repeated here until the polling request frame transmitted in either of the transmission rates as N is receivable from the initiator in the passive mode.
[0164]
And in step S32, when judged with the polling request frame having been transmitted from the initiator in the passive mode (i.e., when a NFC communication device carries out normal reception of the polling request frame of the n-th rate), it progresses to step S35, and with a random number, a NFC communication device generates own NFCID and progresses to step S36 while determining the transmission rate between initiators as the n-th rate. At step S36, a NFC communication device transmits the polling response frame which has arranged own NFCID at the n-th rate, and progresses to step S37.
[0165]
Here, a NFC communication device communicates at the n-th rate, unless modification of a transmission rate is directed by transmitting command PSL_REQ from the initiator in the passive mode at step S36, after transmitting a polling response frame at the n-th rate.
[0166]
At step S37, a NFC communication device waits to transmit command DSL_REQ to step S37 from the initiator in return and the passive mode, when it judges [judging whether command DSL_REQ has been transmitted and not having been transmitted from the initiator in the passive mode, and].
[0167]
Moreover, in step S37, when judged with command DSL_REQ having been transmitted from the initiator in the passive mode (i.e., when a NFC communication device receives command DSL_REQ), it progresses to step S38, and a NFC communication device transmits response DSL_REQ to command DSL_REQ, will be in a DISEREKUTO condition, and will progress to step S39.
[0168]
At step S39, a NFC communication device ends processing, after performing the communications processing (communications processing of the target in the passive mode) and completing the communications processing of the target in the passive mode as a target in the passive mode. In addition, about the communications processing of the target in the passive mode, it mentions later.
[0169]
Next, with reference to the flow chart of drawing 16 , processing of the initiator in the active mode by the NFC communication device is explained.
[0170]
In processing of the initiator in the active mode, step S11 of processing of the initiator in the passive mode of drawing 14 thru/or the respectively same processing as the case in S21 are performed in step S51 thru/or S61. However, in processing of the initiator in the passive mode of drawing 14 , a NFC communication device continues outputting an electromagnetic wave until the processing is completed, but in processing of the initiator in the active mode, only when a NFC communication device transmits data, the points which output an electromagnetic wave differ.
[0171]

That is, in step S51, a NFC communication device starts the output of an electromagnetic wave.

In addition, in step S1 of above-mentioned drawing 13 , step S51 in processing of the initiator in this active mode is performed, when an electromagnetic wave is not detected. That is, in step S1 of drawing 13 , a NFC communication device starts the output of an electromagnetic wave in step S51, when an electromagnetic wave is not detected. Therefore, processing of steps S1 and S51 is equivalent to above-mentioned initial RFCA processing.

[0172]

Then, it progresses to step S52, and a NFC communication device sets the variable n showing a transmission rate to 1 as initial value, and progresses to step S53. At step S53, a NFC communication device is the n-th rate, it transmits a polling request frame, suspends the output of an electromagnetic wave (it is said suitably that RF off processing is performed hereafter), and progresses to step S54.

[0173]

Here, at step S53, a NFC communication device starts the output of an electromagnetic wave by above-mentioned active RFCA processing, before transmitting a polling request frame. However, when Variable n is 1 which is initial value, since the output of an electromagnetic wave is already started by the initial RFCA processing corresponding to processing of steps S1 and S51, it is not necessary by it to perform active RFCA processing.

[0174]

At step S54, from other equipments, a NFC communication device is the n-th rate, and judges whether the polling response frame has been transmitted.

[0175]

In step S54, other equipments which approach for example, a NFC communication device when judged [that a polling response frame has not been transmitted and] from other equipments cannot perform a communication link at the n-th rate, but when the polling response frame to the polling request frame transmitted at the n-th rate does not come on the contrary, step S55 thru/or S57 are skipped, and it progresses to step S58.

[0176]

Moreover, when it is judged with the polling response frame having been transmitted at the n-th rate from other equipments in step S54, Namely, for example, other equipments close to a NFC communication device can perform a communication link at the n-th rate. When the polling response frame to the polling request frame transmitted at the n-th rate comes on the contrary, it progresses to step S55. A NFC communication device As a target in the active mode, while recognizing other equipments which have returned the polling response frame by NFCID arranged in NFCID of the target at the polling response frame It recognizes that the target can communicate at the n-th rate.

[0177]

Here, if a NFC communication device recognizes that the target can communicate with NFCID of the target in the active mode at the n-th rate in step S55, the transmission rate between the target is determined as the n-th rate, and the target will communicate at the n-th rate, unless a transmission rate is changed by command PSL_REQ.

[0178]

Then, it progresses to step S56, and a NFC communication device starts the output of an electromagnetic wave by active RFCA processing, and transmits command DSL_REQ to the target (target in the active mode) of NFCID recognized at step S55 at the n-th rate.

Thereby, the target will be in the DISEREKUTO condition which does not answer the polling request frame transmitted henceforth. Then, a NFC communication device performs RF off processing, and progresses to S57 from step S56.

[0179]

At step S57, a NFC communication device receives response DSL_RES which the target made a DISEREKUTO condition by the command DSL_REQ returns to command DSL_REQ which transmitted at step S56, and progresses to step S58.

[0180]

In step S58, at step S53, a NFC communication device judges whether predetermined time amount passed, after transmitting a polling request frame at the n-th rate.

[0181]

In step S58, after transmitting a polling request frame at the n-th rate by step S53, when it is still judged with predetermined time amount having not passed, step S53 thru/or processing of S58 are repeated by step S53 return and the following.

[0182]

On the other hand, after transmitting a polling request frame at the n-th rate by step S53, when it is judged with predetermined time amount having passed in step S58, it progresses to step S59 and judges whether a NFC communication device is equal to N whose variable n is the maximum. In step S59, when it judges that Variable n is not equal to Maximum N (i.e., when Variable n is under the maximum N), it progresses to

step S60, and only 1 increments Variable n and, as for a NFC communication device, step S53 thru/or processing of S60 are repeated by step S53 return and the following in it.

[0183]

Here, while a NFC communication device is a transmission rate as N by repeating step S53 thru/or processing of S60 and transmitting a polling request frame, the polling response frame which comes by each transmission rate on the contrary is received.

[0184]

When it judges that Variable n is equal to Maximum N, on the other hand in step S59, a NFC communication device at the transmission rate as N as N While transmitting a polling request frame, when the polling response frame which comes by each transmission rate on the contrary is received, it progresses to step S61. A NFC communication device As an initiator in the active mode, the communications processing (communications processing of the initiator in the active mode) is performed, and processing is ended after that. Here, about the communications processing of the initiator in the active mode, it mentions later.

[0185]

Next, with reference to the flow chart of drawing 17 , processing of the target in the active mode by the NFC communication device is explained.

[0186]

In processing of the target in the active mode, step S31 of processing of the target in the passive mode of drawing 15 thru/or the respectively same processing as the case in S39 are performed in step S71 thru/or S79. However, although data are transmitted in processing of the target in the passive mode of drawing 15 when a NFC communication device carries out the load modulation of the electromagnetic wave which the initiator in the passive mode outputs, it differs in processing of the target in the active mode in that a NFC communication device outputs an electromagnetic wave in person, and data are transmitted.

[0187]

That is, in processing of the target in the active mode, step S31 of drawing 15 thru/or the respectively same processing as the case in S35 are performed in step S71 thru/or S75.

[0188]

And it progresses to step S76 after processing of step S75, and a NFC communication device starts the output of an electromagnetic wave by active RFCA processing, and transmits the polling response frame which has arranged own NFCID at the n-th rate. Furthermore, at step S76, a NFC communication device performs RF OFF processing, and progresses to step S77.

[0189]

Here, a NFC communication device communicates at the n-th rate, unless modification of a transmission rate is directed by transmitting command PSL_REQ from the initiator in the active mode at step S76, after transmitting a polling response frame at the n-th rate.

[0190]

At step S77, a NFC communication device waits to transmit command DSL_REQ to step S77 from the initiator in return and the active mode, when it judges [judging whether command DSL_REQ has been transmitted and not having been transmitted from the initiator in the active mode, and].

[0191]

Moreover, in step S77, when judged with command DSL_REQ having been transmitted from the initiator in the active mode (i.e., when a NFC communication device receives command DSL_REQ), it progresses to step S78, and a NFC communication device starts the output of an electromagnetic wave by active RFCA processing, and transmits response DSL_REQ to command DSL_REQ. Furthermore, at step S78, a NFC communication device performs RF OFF processing, will be in a DISEREKUTO condition, and will progress to step S79.

[0192]

At step S79, a NFC communication device ends processing, after performing the communications processing (communications processing of the target in the active mode) and completing the communications processing of the target in the active mode as a target in the active mode. In addition, about the communications processing of the target in the active mode, it mentions later.

[0193]

Next, with reference to the flow chart of drawing 18 and drawing 19 , the communications processing of the initiator in the passive mode in step S21 of drawing 14 is explained.

[0194]

In step S91, the NFC communication device which is the initiator in the passive mode chooses the equipment (suitably henceforth attention equipment) which communicates from the targets which have recognized NFCID at step S15 of drawing 14 , and progresses to step S92. At step S92, command WUP_REQ is transmitted to attention equipment and this cancels the DISEREKUTO condition of the attention

equipment made into the DISEREKUTO condition by transmitting command DSL_REQ at step S16 of drawing 14 (it is suitably said for the Wake rise that it carries out hereafter).

[0195]

Then, attention equipment waits to transmit response WUP_RES to command WUP_REQ, and progresses to S93 from step S92, and a NFC communication device receives the response WUP_RES, and progresses to step S94. At step S94, a NFC communication device transmits command ATR_REQ to attention equipment. And attention equipment waits to transmit response ATR_RES to command ATR_REQ, and progresses to S95 from step S94, and a NFC communication device receives the response ATR_RES.

[0196]

Here, a NFC communication device and attention equipment recognize mutually the transmission rate with which a partner can communicate because a NFC communication device and attention equipment exchange command ATR_REQ by which an attribute is arranged as mentioned above, and response ATR_RES.

[0197]

Then, it progresses to S96 from step S95, and a NFC communication device transmits command DSL_REQ to attention equipment, and changes attention equipment into a DISEREKUTO condition. And attention equipment waits to transmit response DSL_RES to command DSL_REQ, and progresses to S97 from step S96, and a NFC communication device receives the response DSL_RES, and progresses to step S98.

[0198]

At step S98, it judges whether the NFC communication device chose all the targets that have recognized NFCID at step S15 of drawing 14 as attention equipment at step S91. In step S98, when a NFC communication device judges with there being a target which has not been chosen as attention equipment yet, to step S91, return and a NFC communication device are newly [one] of the targets which have not been chosen as attention equipment chosen as attention equipment, and still repeat the same processing hereafter.

[0199]

In step S98, a NFC communication device moreover, all the targets that have recognized NFCID at step S15 of drawing 14 When it judges with having chosen as attention equipment at step S91, a NFC communication device among all the targets that have recognized NFCID Command ATR_REQ and response ATR_RES are exchanged. By this When the transmission rate with which each target can communicate has been recognized, it progresses to step S99. A NFC communication device The equipment (attention equipment) which communicates is chosen from the targets which exchanged command ATR_REQ and response ATR_RES at steps S94 and S95, and it progresses to step S100.

[0200]

At step S100, a NFC communication device transmits command WUP_REQ to attention equipment, and, thereby, carries out the Wake rise of the attention equipment made into the DISEREKUTO condition by transmitting command DSL_REQ at step S96. And attention equipment waits to transmit response WUP_RES to command WUP_REQ, and progresses to S101 from step S100, and a NFC communication device receives the response WUP_RES, and progresses to step S111 of drawing 19 .

[0201]

At step S111, a NFC communication device judges whether communications parameters, such as a transmission rate at the time of performing a communication link with attention equipment, are changed.

[0202]

Here, at step S95 of drawing 18 , the NFC communication device has received response ATR_RES from attention equipment, and recognizes communications parameters, such as a transmission rate with which attention equipment can communicate, based on the attribute arranged at the response ATR_RES. A NFC communication device judges with changing a communications parameter in step S111 between for example, attention equipment, that a transmission rate should be changed into a more nearly high-speed transmission rate, when it can communicate at a high-speed transmission rate rather than a current transmission rate. Moreover, when current communication environment is an environment where a noise level is high, in order to fall a transmission error that a NFC communication device can communicate at a low-speed transmission rate rather than a current transmission rate between for example, attention equipment, in step S111, it judges with changing a communications parameter that a transmission rate should be changed into a low speed transmission rate. In addition, even if it is the case which can communicate at a different transmission rate from a current transmission rate between a NFC communication device and attention equipment, it is possible to continue a communication link with a current transmission rate.

[0203]

In step S111, when judged with not changing the communications parameter at the

time of performing a communication link with attention equipment (i.e., when continuing a communication link between a NFC communication device and attention equipment with current communications parameters, such as a current transmission rate), step S112 thru/or S114 are skipped, and it progresses to step S115.

[0204]

Moreover, in step S111, when judged with changing the communications parameter at the time of performing a communication link with attention equipment, it progresses to step S112, and a NFC communication device arranges the value of the communications parameter after the modification to command PSL_REQ, and transmits it to attention equipment. And attention equipment waits to transmit response PSL_RES to command PSL_REQ, and progresses to S113 from step S112, and a NFC communication device receives the response PSL_RES, and progresses to step S114.

[0205]

A NFC communication device is changed into the value of the communications parameter which has arranged communications parameters, such as a transmission rate at the time of performing the communication link with attention equipment, to command PSL_REQ which transmitted at step S112 at step S114. A NFC communication device performs the communication link with attention equipment according to communications parameters, such as a transmission rate of the value changed at step S114, unless the exchange of command PSL_REQ and response PSL_RES is henceforth carried out again between attention equipment.

[0206]

In addition, according to the exchange (negotiation) of command PSL_REQ and response PSL_RES, it is possible to also make a change of encoding methods other than [16 (decoding section 14)] a transmission rate (for example, the encoding section of drawing 4), the modulation technique of the modulation section 19 and the load modulation section 20 (recovery section 13), etc.

[0207]

Then, it progresses to step S115, and when it judges whether there are any data which should be transmitted and received between attention equipment and is judged with there being nothing, a NFC communication device skips steps S116 and S117, and progresses to step S118.

[0208]

Moreover, in step S115, when judged with there being data which should be transmitted and received between attention equipment, it progresses to step S116 and a NFC communication device transmits command DEP_REQ to attention equipment. Here, at step S116, when there are data which should be transmitted to attention equipment, a NFC communication device arranges the data to command DEP_REQ, and is transmitted.

[0209]

And attention equipment waits to transmit response DEP_RES to command DEP_REQ, and progresses to S117 from step S116, and a NFC communication device receives the response DEP_RES, and progresses to step S118.

[0210]

As mentioned above, the so-called transmission and reception of live data are performed by exchanging command DEP_REQ and response DEP_RES between a NFC communication device and attention equipment.

[0211]

At step S118, a NFC communication device judges whether a communications partner is changed. In step S118, when judged with not changing a communications partner (i.e., when there are still data exchanged between attention equipment for example), the same processing is repeated by step S111 return and the following.

[0212]

Moreover, in step S118, when judged with changing a communications partner (i.e., although there are no data exchanged between for example, attention equipment, when there are data exchanged with other communications partners), it progresses to step S119 and a NFC communication device transmits command DSL_REQ or RLS_REQ to attention equipment. And attention equipment waits to transmit response DSL_RES or RLS_RES to command DSL_REQ or RLS_REQ, and progresses to S120 from step S119, and a NFC communication device receives the response DSL_RES or RLS_RES.

[0213]

Here, as mentioned above, when a NFC communication device transmits command DSL_REQ or RLS_REQ to attention equipment, the target as the attention equipment is released from the object of the communication link with the NFC communication device as an initiator. However, although the target released by command DSL_REQ will be in an initiator and the condition which can be communicated again by command WUP_UP, the target released by command RLS_REQ will not be in an initiator and the condition which can be communicated, unless the exchange of the polling request frame mentioned above and a polling response frame is performed between initiators.

[0214]

In addition, as a case where a certain target is released from the object of the communication link with an initiator, others, for example, an initiator, and a target in case command DSL_REQ or RLS_REQ is transmitted from an initiator to a target separate too much, and there is a case where it becomes impossible to perform a contiguity communication link, as mentioned above. In this case, like the target released by command RLS_REQ, between a target and an initiator, unless the exchange of a polling request frame and a polling response frame is performed, it will not be in an initiator and the condition which can be communicated.
[0215]
Here, hereafter, suitably, between a target and an initiator, if the exchange of a polling request frame and a polling response frame is not performed, release of the target an initiator and whose communication link are not attained will be called full release. Moreover, release of the target an initiator and whose communication link are attained again is called release by transmitting command WUP_UP from an initiator temporarily.
[0216]
After processing of step S120 progresses to step S121, and a NFC communication device judges whether full release of all the targets that have recognized NFCID at step S15 of drawing 14 was carried out. In step S121, when judged with full release of all the targets that have recognized NFCID not being carried out yet, to step 99 of drawing 18 , return and a NFC communication device newly choose attention equipment, and repeat the same processing hereafter out of the target by which full release is not carried out, i.e., the target released temporarily.
[0217]
Moreover, in step S121, when judged with full release of all the targets that have recognized NFCID having been carried out, processing is ended.
[0218]
In addition, in steps S116 and S117 of drawing 19 , although transmission and reception (data exchange) of data are performed between a target and an initiator by exchanging command DEP_REQ and response DEP_RES, the exchange of this command DEL_REQ and response DEP_RES is one transaction. Through steps S118, S111, S112, and S113, after processing of steps S116 and S117 can be returned to step S114, and can change a communications parameter. Therefore, communications parameters, such as a transmission rate about the communication link between a target and an initiator, can be changed for every transaction.
[0219]
Moreover, in steps S112 and S113, it is possible by exchanging command PSL_REQ and response PSL_RES between an initiator and a target to change the communicate mode of the initiator which is one of the communications parameters, and a target at step S114. Therefore, the communicate mode of a target and an initiator can be changed for every transaction. In addition, this means that the communicate mode of a target and an initiator must not be changed between one transaction.
[0220]
Next, with reference to the flow chart of drawing 20 , the communications processing of the target in the passive mode in step S38 of drawing 15 is explained.
[0221]
In steps S37 and S38 of drawing 15 , since the NFC communication device which is the target in the passive mode is considering the exchange of response DSL_RES as command DSL_REQ between the initiators in the passive mode, it is in the DISEREKUTO condition.
[0222]
Then, in step S131, a NFC communication device is considered as as [return and a DISEREKUTO condition] at step S131, when it judges whether command WUP_REQ has been transmitted from the initiator and it is judged [not having been transmitted and].
[0223]
Moreover, in step S131, when judged with command WUP_REQ having been transmitted from the initiator (i.e., when a NFC communication device receives command WUP_REQ), it progresses to step S131, and a NFC communication device transmits response WUP_RES to command WUP_REQ, carries out the Wake rise, and progresses to step S133.
[0224]
At step S133, command ATR_REQ judges whether it has been transmitted from the initiator, and when it judges [not having been transmitted and], a NFC communication device skips step S134, and progresses to step S135.
[0225]
Moreover, in step S133, when judged with command ATR_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command ATR_REQ), it progresses to step S135, and a NFC communication device transmits response ATR_RES to command ATR_REQ, and progresses to step S135.
[0226]
At step S135, a NFC communication device judges whether command DSL_REQ has been transmitted from the initiator. In step S135, when judged with command

DSL_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command DSL_REQ), it progresses to step S136, and a NFC communication device transmits response DSL_RES to command DSL_REQ, and returns to step S131. Thereby, a NFC communication device will be in a DISEREKUTO condition.

[0227]

On the other hand, when it is judged [that command DSL_REQ has not been transmitted and] from an initiator in step S135, it progresses to step S137, and a NFC communication device judges whether command PSL_REQ has been transmitted from the initiator, when it judges [not having been transmitted and], it skips steps S138 and S139, and progresses to step S140.

[0228]

Moreover, in step S137, when judged with command PSL_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command PSL_REQ), it progresses to step S138, and a NFC communication device transmits response PSL_RES to command PSL_REQ, and progresses to step S139. At step S139, according to command PSL_REQ from an initiator, a NFC communication device changes the communications parameter, and progresses to step S140.

[0229]

At step S140, when it judges [judging whether command DEP_REQ has been transmitted and not having been transmitted from an initiator, and], a NFC communication device skips step S141, and progresses to step S142.

[0230]

Moreover, in step S140, when judged with command DEP_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command DEP_REQ), it progresses to step S141, and a NFC communication device transmits response DEP_RES to command DEP_REQ, and progresses to step S142.

[0231]

At step S142, when it judges [that a NFC communication device judges whether command RSL_REQ has been transmitted, and has not been transmitted from an initiator, and], the same processing is repeated by step S133 return and the following.

[0232]

Moreover, in step S142, when judged with command RSL_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command RSL_REQ), it progresses to step S143, and a NFC communication device transmits response RSL_RES to command RSL_REQ, thereby, it ends the communication link with an initiator completely, and ends processing.

[0233]

Next, drawing 21 and drawing 22 are flow charts which show the detail of the communications processing of the initiator in the active mode in step S61 of drawing 16 .

[0234]

In addition, by the communications processing of the initiator in the passive mode explained by drawing 18 and drawing 19 , although an initiator is continuing outputting an electromagnetic wave, by the communications processing of the initiator in the active mode of drawing 21 and drawing 22 , by performing active RFCA processing, before transmitting a command, an initiator starts the output of an electromagnetic wave and performs processing (OFF processing) which suspends the output of the electromagnetic wave after termination of transmission of a command. If this point is removed, since the step step S91 of drawing 18 step S111 of S101 and drawing 19 thru/or the respectively same processing as the case in S121 are performed, by the communications processing of the initiator in the active mode of drawing 21 , the explanation will be omitted in step S151 step S171 of S161 and drawing 22 thru/or S181.

[0235]

Next, drawing 23 is a flow chart which shows the detail of the communications processing of the target in the active mode in step S79 of drawing 17 .

[0236]

In addition, although data are transmitted in the communications processing of the target in the passive mode explained by drawing 20 when a target carries out the load modulation of the electromagnetic wave which the initiator is outputting In the communications processing of the target in the active mode of drawing 23 , a target starts the output of an electromagnetic wave by performing active RFCA processing, before transmitting a command, and performs processing (OFF processing) which suspends the output of the electromagnetic wave after termination of transmission of a command. If this point is removed, since step S131 of drawing 20 thru/or the respectively same processing as the case in S143 are performed, by the communications processing of the target in the active mode of drawing 23 , the explanation will be omitted in step S191 thru/or S203.

[0237]

Next, with reference to drawing 24 thru/or drawing 26 , the method of coping with it in a NFC communication device of an as opposed to [hide and / a terminal problem] is

explained.

[0238]

drawing 24 -- three NFC communication devices 1, 2, and 3 — relation with the magnitude of the flux density by the electromagnetic wave is shown at each location and the level of an electromagnetic wave, i.e., here.

[0239]

In drawing 24 , the NFC communication device 2 is in the location which only a certain short distance L12 left from the NFC communication device 1, and the NFC communication device 3 is in the location which only the distance L23 longer than distance L12 separated from the NFC communication device 2. And it is separated only from distance L12+L 23 of the NFC communication devices 1 and 3.

[0240]

the NFC communication device 1 thru/or 3 -- each exchanges data between communications partners by the transformer coupling of the coils as an antenna 11 shown in drawing 4 . In addition, the communications partner of a NFC communication device does not need to be a NFC communication device, and may be the conventional IC card etc. However, like the conventional IC card in the communications partner of a NFC communication device, when supply of power is required, by transformer coupling, a NFC communication device exchanges data, and also performs supply of power.

[0241]

By the way, the electromotive force generated by the transformer coupling of coils is so large that the coils are near, and tends to decline in inverse proportion to the 3rd [about] power of the distance of the coils.

[0242]

Therefore, the flux density by the electromagnetic wave which the NFC communication device 1 outputs carries out monotone reduction in inverse proportion to the 3rd [about] power of the distance from the NFC communication device 1. in addition -- although the flux density by the electromagnetic wave which the NFC communication device 1 outputs can be divided into a carrier component Mcarr1 and the signal component Msig1 as a part of data which transmits become irregular -- this carrier component Mcarr1 and a signal component Msig1 — as shown in drawing 24 , in inverse proportion to the 3rd [about] power of the distance from the NFC communication device 1, it decreases, respectively.

[0243]

the same -- the NFC communication devices 2 and 3 -- the flux density by the electromagnetic wave which each outputs — the NFC communication devices 2 and 3 -- respectively — since — it decreases in inverse proportion to the 3rd [about] power of distance. in addition — drawing 24 — (-- drawing 25 and drawing 26 which are mentioned later -- also setting — the same --) — illustration of the flux density by the electromagnetic wave which the NFC communication device 2 outputs is omitted. Moreover, only the carrier component Mcarr3 is illustrated about the flux density by the electromagnetic wave which the NFC communication device 3 outputs, and illustration of a signal component is omitted.

[0244]

The NFC communication device 1 thru/or 3 are designed so that a with an operating-limits subcarrier flux density [as a predetermined threshold / TH] of two or more (or more size) carrier component may be needed, although data are acquired in the recovery section 13 of drawing 4 .

[0245]

While making the NFC communication device 1 into a transmitting side, when a communication link shall be now performed by making the NFC communication device 2 into a receiving side among the NFC communication devices 1 and 2, for example, in drawing 24 The NFC communication device 2 which is a receiving side is in the location which only the distance L12 whose carrier component Mcarr1 of the electromagnetic wave which the NFC communication device 1 which is a transmitting side outputs corresponds with the operating-limits subcarrier flux density TH2 left, and it exists in the most distant location that can communicate with the NFC communication device 1.

[0246]

Since the carrier component Mcarr1 of the electromagnetic wave from the NFC communication device 1 which the NFC communication device 2 receives serves as smallness from the operating-limits subcarrier flux density TH2, it becomes impossible in addition, for the NFC communication device 2 to receive the data transmitted from the NFC communication device 1, if the distance between the NFC communication devices 1 and 2 serves as size from distance L12. This can be said for the distance which can communicate among the NFC communication devices 1 and 2 to be restricted to less than [distance L12] by the operating-limits subcarrier flux density TH2.

[0247]

Moreover, although the recovery section 13 (drawing 4) acquires data, in order to make it need a with an operating-limits subcarrier flux density [as a threshold / TH]

of two or more carrier component in the NFC communication device 2 For example, only when a with an operating-limits subcarrier flux density [TH] of two or more carrier component is supplied to the recovery section 13 through an antenna 11 and a receive section 12, it sets to the 1st method of operating the recovery section 13, and a detecting element 23. Only when a with an operating-limits subcarrier flux density [TH] of two or more carrier component is detected, there is the 2nd method of operating the recovery section 13. What is necessary is to set up the operating-limits subcarrier flux density TH2 as a threshold, and just to make it detect the electromagnetic wave of with an operating-limits subcarrier flux density [as the threshold / TH] of two or more level in a detecting element 23 in the threshold setting section 24 of drawing 4 , when adopting the 2nd approach.

[0248]

Although the NFC communication device 1 thru/or 3 acquire data in the recovery section 13 as mentioned above Are designed so that the carrier component of with an operating-limits subcarrier flux density [as a predetermined threshold / TH] of two or more level may be needed, and also Furthermore, when the carrier component of with a subcarrier output control decision flux density [as other thresholds / TH] of one or more (or more size) level is not detected in the detecting element 23 (drawing 4), it is designed so that initiation of the output of an electromagnetic wave may be possible.

[0249]

That is, although the NFC communication device 1 thru/or 3 perform RFCA processing which starts the output of an electromagnetic wave when an electromagnetic wave is not detected around as drawing 9 and drawing 10 explained, in this RFCA processing, the case where an electromagnetic wave is not detected means the case where the carrier component of with a subcarrier output control decision flux density [TH] of one or more level is not detected.

[0250]

In drawing 24 , the NFC communication device 1 is in the location from which only distance L12+L 23 (both NFC communication devices 1 and 3 presuppose that it is the minimum distance with the NFC communication devices 1 and 3 which can output an electromagnetic wave to coincidence) from which the carrier component Mcarr3 of the electromagnetic wave which the NFC communication device 3 which is not a communications partner outputs becomes less than one subcarrier output control decision flux density TH in the NFC communication device 1 was separated. In this case, the output of the electromagnetic wave by the NFC communication device 1 is not barred by the output of the electromagnetic wave by the NFC communication device 3.

[0251]

In addition, it declines that it is separated only from distance L12+L 23 from which the carrier component Mcarr3 of the electromagnetic wave which the NFC communication device 3 outputs becomes less than one subcarrier output control decision flux density TH in the NFC communication device 1 of the NFC communication devices 1 and 3 so that the carrier component Mcarr1 of the electromagnetic wave which the NFC communication device 1 outputs may also become less than one subcarrier output control decision flux density TH in the NFC communication device 3. Therefore, the output of the electromagnetic wave by the NFC communication device 3 is not barred by the output of the electromagnetic wave by the NFC communication device 1, either. In addition, the level of the electromagnetic wave which a communication device 1 thru/or 3 output presupposes that it is the same here.

[0252]

As mentioned above, in drawing 24 , the output of an electromagnetic wave is possible also for the NFC communication device 1 which communicates with the NFC communication device 2, and the NFC communication device 3 which is not going to communicate with the NFC communication device 2. And since the NFC communication device 2 is in a location nearer than the NFC communication device 1 to the NFC communication device 3 and it is in a location nearer than the NFC communication device 3 also to the NFC communication device 1, the electromagnetic wave from the NFC communication device 3 will be received on level higher than the NFC communication device 1, and the electromagnetic wave from the NFC communication device 1 will also be received on level higher than the NFC communication device 3.

[0253]

Since it communicates among the NFC communication devices 1 and 2 now, the electromagnetic wave from the NFC communication device 1 which the NFC communication device 2 receives When influenced of the electromagnetic wave from the NFC communication device 3 which the NFC communication device 2 similarly receives The NFC communication device 2 cannot receive normally the data from the NFC communication device 1 which is a communications partner, but the communication link between the NFC communication devices 1 and 2 will be barred by the electromagnetic wave from the NFC communication device 3.

[0254]
Then, operating-limits subcarrier flux density TH2 is made into size from the subcarrier output control decision flux density TH1, and, thereby, is made into the value of extent by which the signal component Msig1 in the electromagnetic wave from the NFC communication device 1 which the NFC communication device 2 receives is not influenced from the carrier component Mcarr3 in the electromagnetic wave from the NFC communication device 3 which the NFC communication device 2 receives.
[0255]
As mentioned above, when distance with the NFC communication devices 1 and 3 is distance L12+L23 which the carrier component Mcarr3 in the electromagnetic wave outputted from the NFC communication device 3 decreases in the NFC communication device 1 to less than one subcarrier output control decision flux density TH Make into the operating-limits subcarrier flux density TH2 the minimum level of the carrier component from which the signal component which the carrier component Mcarr3 by the NFC communication device 3 in the NFC communication device 2 does not influence is obtained, and it is set to the NFC communication device 2. By needing the with an operating-limits subcarrier flux density [TH] of two or more carrier component Mcarr1 as an electromagnetic wave outputted from the NFC communication device 1 although the data from the NFC communication device 1 are acquired preventing that normal reception of the data as a signal component Msig1 transmitted from the NFC communication device 1 in the NFC communication device 2 when the NFC communication device 3 which is not a communications partner outputs an electromagnetic wave is barred -- that is, it can hide and a terminal problem can be solved.
[0256]
That is, in drawing 24 , the NFC communication device 3 which is present in the location where the carrier component Mcarr1 in the electromagnetic wave from the NFC communication device 1 becomes less than one subcarrier output control decision flux density TH can output an electromagnetic wave irrespective of whether the NFC communication device 1 is outputting the electromagnetic wave. That is, the NFC communication devices 1 and 3 can output an electromagnetic wave to coincidence.
[0257]
And in drawing 24 , the NFC communication device 2 receives the carrier component Mcarr3 smaller than the operating-limits subcarrier flux density TH2 from the NFC communication device 3 while receiving the carrier component Mcarr1 of the operating-limits subcarrier flux density TH2 from the NFC communication device 1. The NFC communication device 2 cannot carry out normal reception of the data transmitted from the NFC communication device 3, although normal reception of the data transmitted from the NFC communication device 1 can be carried out since a with an operating-limits subcarrier flux density [TH] of two or more carrier component is needed, although the data transmitted from other equipments are acquired. Furthermore, since it is separated only from distance L12+L 23 which the carrier component Mcarr3 in the electromagnetic wave outputted from the NFC communication device 3 decreases in the NFC communication device 1 to less than one subcarrier output control decision flux density TH of the NFC communication devices 1 and 3 Depending on how to decide the operating-limits subcarrier flux density TH2 mentioned above, the carrier component Mcarr3 which the NFC communication device 2 receives from the NFC communication device 3 does not influence the signal component Msig1 which the NFC communication device 2 receives from the NFC communication device 1. Therefore, the NFC communication device 2 can carry out normal reception of the data transmitted from the NFC communication device 1 irrespective of whether the NFC communication device 3 is outputting the electromagnetic wave.
[0258]
Next, drawing 25 shows the level of an electromagnetic wave in case NFC communication device 2' other than the NFC communication device 1 shown in drawing 24 thru/or 3 exists.
[0259]
To the NFC communication device 1, NFC communication device 2' is a location nearer than the NFC communication device 2, and is located in a distant location rather than the NFC communication device 2 to the NFC communication device 3.
[0260]
In addition, the level (flux density) in NFC communication device #j of carrier component Mcarr#i in the electromagnetic wave which outputs NFC communication device #i, and signal-component Msig#i is hereafter indicated suitably to be carrier component Mcarr#i (#j) and signal-component Msig#i (#j), respectively.
[0261]
In drawing 25 , since NFC communication device 2' is located in a near location rather than the NFC communication device 2 to the NFC communication device 1 supposing the NFC communication device 1 and 2' communicate, the carrier component Mcarr1

(2') which NFC communication device 2' receives from the NFC communication device 1 has the NFC communication device 2 larger than the carrier component Mcarr1 (2) received from the NFC communication device 1. Therefore, the signal component Msig1 (2') which NFC communication device 2' receives from the NFC communication device 1 also has the NFC communication device 2 larger than the signal component Msig1 (2) which receives from the NFC communication device 1.

[0262]

Moreover, since NFC communication device 2' is located in a distant location rather than the NFC communication device 2 to the NFC communication device 3, the carrier component Mcarr3 (2') which NFC communication device 2' receives from the NFC communication device 3 has the NFC communication device 2 smaller than the carrier component Mcarr3 (2) received from the NFC communication device 3.

[0263]

When the NFC communication devices 1 and 2 communicate, the ratio of the signal component Msig1 (2) which the NFC communication device 2 receives from the NFC communication device 1, and the carrier component Mcarr3 (2) which the NFC communication device 2 receives from the NFC communication device 3 turns into SN (Signal Noise) ratio. the same -- NFC -- a communication device -- one -- two -- ' -- a communication link -- carrying out -- a case -- **** -- NFC -- a communication device -- two -- ' -- NFC -- a communication device -- one -- from -- receiving -- a signal component -- Msig -- one (2') -- NFC -- a communication device -- two -- ' -- NFC -- a communication device -- three -- from -- receiving -- a carrier component -- Mcarr -- three (2') -- a ratio -- an SN ratio -- becoming .

[0264]

And as mentioned above, it is smallness from the carrier component Mcarr3 (2) to which the NFC communication device 2 receives the carrier component Mcarr3 (2') which is size and NFC communication device 2' receives from the NFC communication device 3 from the NFC communication device 3 from the signal component Msig1 (2) to which the NFC communication device 2 receives the signal component Msig1 (2') which NFC communication device 2' receives from the NFC communication device 1 from the NFC communication device 1.

[0265]

Therefore, the SN ratio (**Msig1(2')/Mcarr3 (2')) of NFC communication device 2' becomes better than the SN ratio (**Msig1(2) / Mcarr3 (2)) of the NFC communication device 2.

[0266]

As mentioned above, also when NFC communication device 2' which is the communications partner of a NFC communication device is a location nearer than the NFC communication device 2 and is located in a distant location rather than the NFC communication device 2 to the NFC communication device 3 to the NFC communication device 1, it can hide and a terminal problem can be solved.

[0267]

In addition, when NFC communication device 2' is located in a distant location rather than the NFC communication device 2 to the NFC communication device 1, the carrier component Mcarr1 (2') from the NFC communication device 1 received in NFC communication device 2' does not become two or more operating-limits subcarrier flux density TH. Therefore, in this case, primarily, since a communication device 1 and 2' cannot communicate, it hides and a terminal problem is not generated.

[0268]

Next, drawing 26 shows the level of an electromagnetic wave in case NFC communication device 3' other than the NFC communication device 1 shown in drawing 24 thru/or 3 exists.

[0269]

NFC communication device 3' -- the NFC communication devices 1 and 2 -- it is alike, respectively, and it receives and is located in a distant location rather than the NFC communication device 3.

[0270]

therefore -- NFC -- a communication device -- one -- outputting -- an electromagnetic wave -- a carrier component -- Mcarr -- one -- NFC -- a communication device -- three -- ' -- a location -- setting -- a subcarrier -- an output -- control -- decision -- flux density -- TH -- one -- being small -- level -- decreasing -- NFC -- a communication device -- three -- ' -- outputting -- an electromagnetic wave -- a carrier component -- Mcarr -- three -- ' -- the location of the NFC communication device 1 -- setting -- level smaller than the subcarrier output control decision flux density TH1 -- decreasing . For this reason, the NFC communication device 1 and 3' can output an electromagnetic wave to coincidence like the case in the NFC communication devices 1 and 3 in drawing 24 .

[0271]

And since NFC communication device 3' is located in a distant location rather than the NFC communication device 3 to the NFC communication device 2, carrier component Mcarr3' (2) which the NFC communication device 2 receives from NFC communication device 3' has the NFC communication device 2 smaller than the

carrier component Mcarr3 (2) received from the NFC communication device 3.

[0272]

When the NFC communication device 2 communicates with the NFC communication device 1, the electromagnetic wave which the NFC communication device 3 and 3' output is equal to a noise, and as mentioned above, the NFC communication device 2 is smaller [carrier component Mcarr3' (2) which the NFC communication device 2 receives from NFC communication device 3'] than the carrier component Mcarr3 (2) received from the NFC communication device 3.

[0273]

Therefore, about an SN ratio in case the NFC communication device 2 communicates with the NFC communication device 1, the direction of an SN ratio (**Msig1 (2) /Mcarr3' (2)) when NFC communication device 3' is outputting the electric wave becomes good as compared with an SN ratio (**Msig1(2) / Mcarr3 (2)) when the NFC communication device 3 is outputting the electric wave.

[0274]

as mentioned above, the NFC communication devices 1 and 2 with which NFC communication device 3' which is not a communications partner communicates -- even if it is alike, respectively, and receives and is located in a distant location rather than the NFC communication device 3, it can hide and a terminal problem can be solved.

[0275]

In addition, when NFC communication device 3' is located in a near location rather than the NFC communication device 3 to the NFC communication device 1, the carrier component Mcarr1 of the electric-wave magnetic wave which the NFC communication device 1 outputs is with a subcarrier output control decision flux density [TH] of one or more level, and reaches NFC communication device 3'. Therefore, in this case, NFC communication device 3' is that (it does not carry out) which cannot output an electromagnetic wave, it hides and a terminal problem is not generated.

[0276]

Although the NFC communication device 1 outputted the electromagnetic wave in the above-mentioned case, data were transmitted to the NFC communication device 2 here and the NFC communication device 2 explained the case where the data was received The NFC communication device 2 transmits data to the NFC communication device 1, and even if the NFC communication device 1 is the case where the data is received preventing that reception of the data based on the NFC communication device 1 is barred when the NFC communication device 3 outputs an electromagnetic wave -- that is, it can hide and a terminal problem can be solved.

[0277]

That is, when the NFC communication device 2 is the initiator in the passive mode, or when communicating in the active mode, the NFC communication device 2 outputs an electromagnetic wave in person, and transmits data. Since the carrier component of the electromagnetic wave is adult level and reaches the NFC communication device 3 from the subcarrier output control decision flux density TH1 when the NFC communication device 2 located in a near location rather than the NFC communication device 1 outputs an electromagnetic wave to the NFC communication device 3, the NFC communication device 3 cannot output an electromagnetic wave, hides, and does not generate a terminal problem.

[0278]

On the other hand, when the NFC communication device 2 is the target in the passive mode, the NFC communication device 2 transmits data to the NFC communication device 1 by carrying out the load modulation of the electromagnetic wave which the NFC communication device 1 which is the initiator in the passive mode outputs. Therefore, when the signal component which reaches the NFC communication device 1 by the load modulation is influenced of the electromagnetic wave which the NFC communication device 3 outputs, in the NFC communication device 1, the data transmitted from the NFC communication device 2 can be received.

[0279]

Therefore, if it says conversely, when separated only from distance L12+L 23 from which the carrier component Mcarr3 of the electromagnetic wave which the NFC communication device 3 (1) outputs becomes less than one subcarrier output control decision flux density TH of the NFC communication devices 1 and 3 In the NFC communication device 1, if the signal component by the load modulation of the NFC communication device 2 which is not influenced of the carrier component Mcarr3 of the NFC communication device 3 is receivable, the data transmitted from the NFC communication device 2 can be received.

[0280]

As mentioned above, so that the SN ratio to the electromagnetic wave which the NFC communication device 3 of the signal component which reaches the NFC communication device 1 by the load modulation by the NFC communication device 2 outputs may serve as sufficient magnitude The load percent modulation of the load modulation in the NFC communication device 2 is set up. The NFC communication

devices 1 and 3 When separated only from distance L12+L 23 from which the carrier component Mcarr3 of the electromagnetic wave which the NFC communication device 3 (1) outputs becomes less than one subcarrier output control decision flux density TH The time of the minimum SN ratio to which the NFC communication device 1 can carry out normal reception of the data from the NFC communication device 2, without being influenced by the electromagnetic wave from the NFC communication device 3 being securable, By making into the operating-limits subcarrier flux density TH2 the carrier component Mcarr1 of the electromagnetic wave which the NFC communication device 1 outputs in the NFC communication device 2, it can hide and a terminal problem can be solved.

[0281]

Next, by drawing 24 thru/or drawing 26 , as it explained, it hides, and a terminal problem is solved, and control processing (transmit/receive control processing) of the transmission and reception of the data in the case of transmitting and receiving data is explained. In addition, this transmit/receive control processing is performed by the control section 21 of drawing 4 .

[0282]

First, with reference to the flow chart of drawing 27 , transmit/receive control processing of the initiator in the passive mode when a NFC communication device becomes the initiator in the passive mode is explained.

[0283]

First, in step S211, a control section 21 (drawing 4) returns to step S211, when it judges with having judged and detected whether the electromagnetic wave of with a subcarrier output control decision flux density [TH] of one or more level was detected in the detecting element 23. That is, since an electromagnetic wave cannot be outputted when the electromagnetic wave of with a subcarrier output control decision flux density [TH] of one or more level is detected, the judgment of whether the electromagnetic wave of with a subcarrier output control decision flux density [TH] of one or more level was detected is continued. In addition, when processing of step S211 is performed, the threshold setting section 24 sets the threshold supplied to a detecting element 23 as the subcarrier output control decision flux density TH1, and supplies it to a detecting element 23.

[0284]

And in step S211, when judged with the electromagnetic wave of with a subcarrier output control decision flux density [TH] of one or more level not being detected, it progresses to step S212, and a control section 21 permits the output of the electromagnetic wave by the electromagnetic wave output section 18, and transmission of the data based on modulating the electromagnetic wave, and progresses to step S213. Thereby, the electromagnetic wave output section 18 starts the output of an electromagnetic wave, and the modulation section 19 will be in the condition which can modulate an electromagnetic wave. In addition, as mentioned above, the initiator in the passive mode continues outputting an electromagnetic wave until the communication link with a target is completed.

[0285]

At step S213, a control section 21 permits the reception and the recovery of data which are transmitted when the target in the passive mode carries out the load modulation of the electromagnetic wave which self is outputting to the recovery section 13, and progresses to step S214. Thereby, in the recovery section 13, the recovery of the data transmitted when the target in the passive mode carries out the load modulation of the electromagnetic wave which the initiator in the passive mode is outputting is started.

[0286]

Then, it progresses to step S214, and when it judges with a control section 21 judging whether the communication link with the target in the passive mode was completed completely, and not being completed, it returns to step S214. Moreover, in step S214, when judged with the communication link with the target in the passive mode having been completed completely, a control section 21 forbids the output of the electromagnetic wave by the electromagnetic wave output section 18, and reception of the data based on restoring to the electromagnetic wave which transmitted and modulated [load] the data based on modulating the electromagnetic wave, and ends processing.

[0287]

Next, with reference to the flow chart of drawing 28 , transmit/receive control processing of the target in the passive mode when a NFC communication device becomes the target in the passive mode is explained.

[0288]

First, in step S221, a control section 21 (drawing 4) judges whether in the detecting element 23, the electromagnetic wave of with an operating-limits subcarrier flux density [TH] of two or more level was detected. In addition, when processing of step S221 is performed, the threshold setting section 24 sets the threshold supplied to a detecting element 23 as the operating-limits subcarrier flux density TH2, and supplies it to a detecting element 23.

[0289]
In step S221, when judged with the electromagnetic wave of with an operating-limits subcarrier flux density [TH] of two or more level having been detected, it progresses to step S222, and a control section 21 permits reception of the data based on restoring to the electromagnetic wave transmitted from the initiator in the passive mode, and transmission of the data based on carrying out the load modulation of the electromagnetic wave, and progresses to step S224. Thereby, the load modulation section 20 will be in the condition which can perform the load modulation of an electromagnetic wave, and the recovery section 13 will start the recovery of the electromagnetic wave which the initiator in the passive mode is outputting.
[0290]
On the other hand, when judged with the electromagnetic wave of with an operating-limits subcarrier flux density [TH] of two or more level not being detected in step S221, it progresses to step S223, and a control section 21 forbids reception of the data based on restoring to an electromagnetic wave by the recovery section 13, and transmission of the data based on carrying out the load modulation of the electromagnetic wave by the load modulation section 20, and progresses to step S224.
[0291]
At step S224, when it judges with a control section 21 judging whether the communication link with the initiator in the passive mode was completed completely, and not being completed, it returns to step S221. Moreover, in step S221, when judged with the communication link with the initiator in the passive mode having been completed completely, a control section 21 forbids reception of the data based on restoring to an electromagnetic wave by the recovery section 13, and transmission of the data based on carrying out the load modulation of the electromagnetic wave by the load modulation section 20, and ends processing.
[0292]
Next, with reference to the flow chart of drawing 29 , transmit/receive control processing of the initiator in the active mode when a NFC communication device becomes the initiator in the active mode is explained.
[0293]
First, in step S231, a control section 21 (drawing 4) judges whether in the detecting element 23, the electromagnetic wave of with a subcarrier output control decision flux density [TH] of one or more level was detected. In addition, when processing of step S231 is performed, the threshold setting section 24 sets the threshold supplied to a detecting element 23 as the subcarrier output control decision flux density TH1, and supplies it to a detecting element 23.
[0294]
In step S231, when judged with the electromagnetic wave of with a subcarrier output control decision flux density [TH] of one or more level having been detected, it progresses to step S232, and a control section 21 forbids the output of the electromagnetic wave by the electromagnetic wave output section 18, and transmission of the data based on modulating an electromagnetic wave by the modulation section 19, and progresses to step S234. That is, since an electromagnetic wave cannot be outputted when the electromagnetic wave of with a subcarrier output control decision flux density [TH] of one or more level is detected, the output of an electromagnetic wave, as a result transmission of the data based on the electromagnetic wave are forbidden.
[0295]
Moreover, in step S231, when judged with the electromagnetic wave of with a subcarrier output control decision flux density [TH] of one or more level not being detected, it progresses to step S233, and a control section 21 permits the output of the electromagnetic wave by the electromagnetic wave output section 18, and transmission of the data based on modulating the electromagnetic wave, and progresses to step S234. the electromagnetic wave output section 18 starts the output of an electromagnetic wave by this -- moreover, it will be in a respectively possible condition that the modulation section 19 modulates an electromagnetic wave.
[0296]
At step S234, a control section 21 judges whether in the detecting element 23, the electromagnetic wave of with an operating-limits subcarrier flux density [TH] of two or more level was detected. In addition, when processing of step S234 is performed, the threshold setting section 24 sets the threshold supplied to a detecting element 23 as the operating-limits subcarrier flux density TH2, and supplies it to a detecting element 23.
[0297]
In step S234, when judged with the electromagnetic wave of with an operating-limits subcarrier flux density [TH] of two or more level having been detected, it progresses to step S235, and a control section 21 permits reception of the data based on restoring to the electromagnetic wave transmitted from the target in the active mode, and progresses to step S237. Thereby, the recovery section 13 will be in the condition which can restore to the electromagnetic wave which the target in the active mode outputs.

[0298]
On the other hand, when judged with the electromagnetic wave of with an operating-limits subcarrier flux density [TH] of two or more level not being detected in step S234, it progresses to step S236, and a control section 21 forbids reception of the data based on restoring to an electromagnetic wave by the recovery section 13, and progresses to step S237.
[0299]
At step S237, when it judges with a control section 21 judging whether the communication link with the target in the active mode was completed completely, and not being completed, it returns to step S231. Moreover, in step S237, when judged with the communication link with the target in the active mode having been completed completely, a control section 21 forbids the output of the electromagnetic wave by the electromagnetic wave output section 18, reception of the data based on restoring to an electromagnetic wave by the recovery section 13, and transmission of the data based on modulating an electromagnetic wave by the modulation section 19, and ends processing.
[0300]
Next, drawing 30 shows the flow chart explaining transmit/receive control processing of the target in the active mode when a NFC communication device becomes the target in the active mode. In addition, in transmit/receive control processing of the target in the active mode, in step S241 thru/or S247, since step S231 of drawing 29 thru/or the respectively same processing as the case in S237 are performed, the explanation is omitted.
[0301]
As mentioned above, in a NFC communication device, since the electromagnetic wave of with an adult operating-limits subcarrier flux density [TH] of two or more level is needed from the subcarrier output control decision flux density TH1 although the output of an electromagnetic wave is started and normal reception of the data is carried out when the electromagnetic wave of with a subcarrier output control decision flux density [TH] of one or more level is not detected, it can perform hiding and solving a terminal problem easily only by detection of an electromagnetic wave.
[0302]
That is, in a NFC communication device, since control logic, memory, etc. which are needed when [which is depended on the commands RTS and CTS mentioned above] hiding and adopting the solution technique of a terminal problem are not needed, by low cost, it can hide and a terminal problem can be solved.
[0303]
Furthermore, in a NFC communication device, since it is not necessary to exchange Commands RTS and CTS, it can hide and a terminal problem can be solved quickly.
[0304]
Moreover, in a NFC communication device, although normal reception of the data is carried out, since the electromagnetic wave of with an adult operating-limits subcarrier flux density [TH] of two or more level is needed from the subcarrier output control decision flux density TH1, the distance for transmitting and receiving data between communications partners can be restrained within a certain fixed distance. Furthermore, the radio channel by transformer coupling is established by using an antenna 11 as a coil, and since it was made for attenuation of an electromagnetic wave to also serve as size when the distance of NFC communication devices served as size, constraint of distance with the communications partner for carrying out normal reception of the data can be made firm (what must be protected).
[0305]
Moreover, in the above-mentioned case, when the electromagnetic wave of with an operating-limits subcarrier flux density [TH] of two or more level was not detected in the detecting element 23, were made not to receive data by forbidding the recovery of the data in the recovery section 13, but in addition, when supply of the power from a communications partner constitutes a NFC communication device like the conventional IC card so that it may be required If the electromagnetic wave of with an operating-limits subcarrier flux density [TH] of two or more level is not received, the electromagnetic wave of with an operating-limits subcarrier flux density [TH] of two or more level can be needed for reception of data by power required for actuation of equipment being made not to be obtained.
[0306]
Furthermore, in an above-mentioned case, in the threshold setting section 24, set up the subcarrier output control decision flux density TH1 or the operating-limits subcarrier flux density TH2 as a threshold, and it sets to a detecting element 23. Although it was made to detect the electromagnetic wave of the level of the subcarrier output control decision flux density TH1 and 2 or more each of operating-limits subcarrier flux density TH As drawing 4 explained, it is able to form detecting elements 23 and 25 and to make it for the electromagnetic wave of the level of the subcarrier output control decision flux density TH1 and 2 or more each of operating-limits subcarrier flux density TH to make each detect. However, the direction which is only a detecting element 23 and the electromagnetic wave of with

the subcarrier output control decision flux density TH1 and an operating-limits subcarrier flux density [TH] of two or more level detects is advantageous in cost rather than it prepares two of detecting elements 23 and 25.

[0307]

In addition, it is not necessary to necessarily process the processing step explaining the processing which a NFC communication device performs to time series in accordance with the sequence indicated as a flow chart, and it is a juxtaposition thing also including the processing (for example, parallel processing or processing by the object) performed according to an individual in this specification.

[0308]

Moreover, although the gestalt of this operation explained the case where this invention was applied to the NFC communication device which can transmit and receive the data in two or more transmission rates, in addition to this, this invention is applicable to the communication device which can only transmit and receive the data in a certain single transmission rate.

[0309]

[Effect of the Invention]

According to this invention, like the above, it becomes possible to hide and to solve a terminal problem easily.

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the example of a configuration of the gestalt of 1 operation of the communication system which applied this invention.

[Drawing 2] It is drawing explaining the passive mode.

[Drawing 3] It is drawing explaining the active mode.

[Drawing 4] It is the block diagram showing the example of a configuration of the NFC communication device 1.

[Drawing 5] It is the block diagram showing the example of a configuration of the recovery section 13.

[Drawing 6] It is the block diagram showing the example of a configuration of the modulation section 19.

[Drawing 7] It is the block diagram showing other examples of a configuration of the recovery section 13.

[Drawing 8] It is the block diagram showing the example of a configuration of further others of the recovery section 13.

[Drawing 9] It is a timing chart explaining initial RFCA processing.

[Drawing 10] It is a timing chart explaining active RFCA processing.

[Drawing 11] It is drawing explaining SDD processing.

[Drawing 12] It is drawing showing the list of a command and responses.

[Drawing 13] It is a flow chart explaining processing of a NFC communication device.

[Drawing 14] It is the flow chart which shows processing of the initiator in the passive mode.

[Drawing 15] It is the flow chart which shows processing of the target in the passive mode.

[Drawing 16] It is the flow chart which shows processing of the initiator in the active mode.

[Drawing 17] It is the flow chart which shows processing of the target in the active mode.

[Drawing 18] It is the flow chart which shows the communications processing of the initiator in the passive mode.

[Drawing 19] It is the flow chart which shows the communications processing of the initiator in the passive mode.

[Drawing 20] It is the flow chart which shows the communications processing of the target in the passive mode.

[Drawing 21] It is the flow chart which shows the communications processing of the initiator in the active mode.

[Drawing 22] It is the flow chart which shows the communications processing of the initiator in the active mode.

[Drawing 23] It is the flow chart which shows the communications processing of the target in the active mode.

[Drawing 24] It is drawing which hides and explains the management to a terminal problem.

[Drawing 25] It is drawing which hides and explains the management to a terminal problem.

[Drawing 26] It is drawing which hides and explains the management to a terminal problem.

[Drawing 27] It is the flow chart which shows transmit/receive control processing of the initiator in the passive mode.

[Drawing 28] It is the flow chart which shows transmit/receive control processing of the target in the passive mode.

[Drawing 29] It is the flow chart which shows transmit/receive control processing of the initiator in the active mode.

[Drawing 30] It is the flow chart which shows transmit/receive control processing of

the target in the active mode.

[Description of Notations]

1 thru/or 3 NFC communication device 11 An antenna, 12 Receive section 13 The recovery section, 14 Decoding section 15 The data-processing section, 16 Encoding section 17 The selection section, 18 Electromagnetic wave output section 19 The modulation section, 20 Load modulation section 21 A control section, 22 Power supply section 23 A detecting element, 24 Threshold setting section 25 detecting elements 31 Selection section 321 thru/or 32Ns Recovery section 33 41 Selection section 421 thru/or 42Ns Modulation section 43 Selection section 51 Adjustable rate recovery section 52 Rate detecting element

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[Translation done.]

TECHNICAL FIELD

[Field of the Invention]

Especially this invention relates to the so-called communication system which is produced in radio, such as for example, a contiguity communication link, about a communication device and a correspondence procedure in communication system and a list and which hides and enables it to solve a terminal problem easily, and a list at a communication device and a correspondence procedure.

[0002]

[Translation done.]

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PRIOR ART

[Description of the Prior Art]

As a system which performs a contiguity communication link, IC (Integrated Curcuit) system is known widely, for example. In IC card system, when reader/writer generates an electromagnetic wave, the so-called RF (Radio Frequency) field (field) is formed. And by electromagnetic induction, if an IC card approaches reader/writer, an IC card will perform data transmission between reader/writers while receiving supply of a power source.

[0003]

By the way, as a specification of IC card system by which current operation is carried out, there are some which are called Type A, Type B, and Type C, for example.

[0004]

Type A is adopted as Philips's MIFARE method, encoding of the data based on Miller is carried out to the data transmission from reader/writer to an IC card, and encoding of the data based on Manchester is carried out to the data transmission from an IC card to reader/writer at it. Moreover, by Type A, 106kbps (kilo bit per second) is adopted as a transmission rate of data.

[0005]

By Type B, encoding of the data based on NRZ is carried out to the data transmission from reader/writer to an IC card, and encoding of the data twisted for the data transmission from an IC card to reader/writer NRZ-L is carried out to it. Moreover, by Type B, 106kbps is adopted as a transmission rate of data.

[0006]

Type C is adopted as a FeliCa method of Sony Corp. which is this applicant, and

encoding of the data based on Manchester is carried out to the data transmission between reader/writer and an IC card. Moreover, by Type C, 212kbps is adopted as a transmission rate of data.

[0007]

By the way, in radio, such as a contiguity communication link, since [so-called] it hides and a terminal problem arises, how it corresponds to it poses a problem.

[0008]

For example, in the system of the conventional wireless LAN (Local Area Network), generally, it is exchanging Commands RTS (Request to send) and CTS (Clear to send) during data communication, and it hides and the terminal problem is coped with (for example, nonpatent literature 1).

[0009]

Here, it hides and, generally a terminal problem means the following problems.

[0010]

That is, in radio, in case it is going to transmit to the communication device of another side from one side of them about two or more communication devices, control is performed so that an electric wave (electromagnetic wave) may not be taken out to coincidence. The communication device which is going to output the electric wave does not output an electric wave, when a surrounding electric wave is detected and an electric wave is detected around, but when an electric wave is not detected around, specifically, it outputs an electromagnetic wave. Thereby, one communication device and the communication device of another side share an electric wave by turns, and exchange data.

[0011]

As mentioned above, when the communication device which is going to output the electric wave performs the output control of the electric wave by self only by the existence of detection of a surrounding electromagnetic wave, the situation that data are transmitted to coincidence from two or more of other communication devices may occur to a certain communication device, and reception of data may go wrong in a certain communication device.

[0012]

That is, suppose that three communication devices A, B, and C exist now. And communication devices A and B presuppose that communication devices B and C are also in the distance which can carry out use control of the electric wave exclusively among both while being in the distance which can carry out use control of the electric wave exclusively among both. However, communication devices A and C presuppose that there is nothing in the distance which can carry out use control of the electric wave exclusively among both.

[0013]

In this case, a communication device B cannot output an electric wave, while outputting the electric wave with either the communication device A or the communication devices C. However, a communication device A can output an electric wave, even if the communication device C is outputting the electric wave. A communication device A can output an electric wave for it, even if the communication device C is outputting the electric wave.

[0014]

When communication devices A and C are in the above physical relationship, an electric wave (data) may be transmitted to coincidence from both communication devices A and C to a communication device B. And if the distance from a communication device B to each of communication devices A and C is equal and communication devices A and C, for example, output the electric wave of the same reinforcement, in a communication device B, the data with which the electric wave outputted from each of communication devices A and C is received by the same reinforcement, consequently communication devices A and C are transmitted by interference either are also normally unreceivable.

[0015]

As mentioned above, from a communication device A, that a communication device B cannot receive data normally cannot check existence of a communication device C, although existence of a communication device B can be checked, but although existence of a communication device B can be checked also from a communication device C, it originates in the ability of existence of a communication device A not to be checked. Thus, another side originates in hiding so to speak and it not being visible from each of communication devices A and C, and in a communication device B, by outputting an electric wave to coincidence from communication devices A and C, the problem which interference produces hides and is called a terminal problem.

[0016]

So, in the conventional wireless LAN, the communication device of the communication link origin which starts a communication link transmits the command RTS which reports communication link time amount (space occupancy time amount) etc. to the communication device of a communications partner.

The communication device of the communications partner which received Command RTS returns the command CTS which reports the comprehension to Command RTS,

communication link time amount (space occupancy time amount), etc. to the communication device of a communicating agency. Other communication devices which are in the distance which can receive the commands RTS or CTS by the communicating agency or the communication device of a communications partner recognize occupancy of the space between a certain space occupancy time amount with the commands RTS or CTS, and it refrains from transmission of an electric wave (data) between the space occupancy time amount.

[0017]

In the communication devices A and C in above-mentioned physical relationship, a communication device A transmits Command RTS to a communication device B, and a communication device B transmits the command CTS as a response to the command RTS to a communication device A. A communication device C can receive the command CTS which the communication device B transmitted, and if a communication device C receives the command CTS which the communication device B transmitted, it is avoidable that the electric wave (data) from communication devices A and C collides sending out of an electric wave in bracing, consequently a communication device B.

[0018]

[Nonpatent literature 1]

ANSI/IEEE Std 802.11, 1999 Edition, LOCAL AND METROPOLITAN AREA NETWORKS: WIRELESS LAN and Chapter 9 MAC sublayer functional description

[0019]

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention]

According to this invention, like the above, it becomes possible to hide and to solve a terminal problem easily.

[Translation done.]

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]

However, it hid, and the solution technique of a terminal problem needed control logic, memory, etc. for it for the communication device, and had the technical problem by Commands RTS and CTS in which cost goes up.

[0020]

This invention is made in view of such a situation, hides, and enables it to solve a terminal problem easily.

[0021]

[Translation done.]

MEANS

[Means for Solving the Problem]

The communication system of this invention starts the output of an electromagnetic wave, when, as for the 1st communication device, the electromagnetic wave of the level beyond the 1st threshold is not detected in the detection means, and the 2nd communication device is characterized by needing the electromagnetic wave of the level beyond the 2nd adult threshold from the 1st threshold, although data are acquired in a recovery means.

[0022]

It is characterized by the 1st communication device of this invention communicating with other equipments in the location at which the output of an electromagnetic wave is started and the electromagnetic wave arrives on the level beyond the 2nd adult threshold from the 1st threshold, when the electromagnetic wave of the level beyond the 1st threshold is not detected in the detection means.

[0023]

It is characterized by communicating with other equipments which the 1st correspondence procedure of this invention has in the location at which the output of an electromagnetic wave is started and the electromagnetic wave arrives on the level beyond the 2nd adult threshold from the 1st threshold when the electromagnetic wave of the level beyond the 1st threshold is not detected in the detection step.

[0024]

The 2nd communication device of this invention is characterized by needing the electromagnetic wave of the level beyond the 2nd adult threshold from the 1st threshold, although data are acquired in a recovery means, when other equipments check that the electromagnetic wave of the level beyond the 1st threshold does not exist and start the output of an electromagnetic wave.

[0025]

The 2nd correspondence procedure of this invention is characterized by needing the electromagnetic wave of the level beyond the 2nd adult threshold from the 1st threshold, although data are acquired in a recovery step, when other equipments check that the electromagnetic wave of the level beyond the 1st threshold does not exist and start the output of an electromagnetic wave.

[0026]

In the communication system of this invention, when, as for the 1st communication device, the electromagnetic wave of the level beyond the 1st threshold is not detected, the output of an electromagnetic wave is started, and the 2nd communication device needs the electromagnetic wave of the level beyond the 2nd adult threshold from the 1st threshold, although data are acquired.

[0027]

In the 1st communication device and correspondence procedure of this invention, when the electromagnetic wave of the level beyond the 1st threshold is not detected, the output of an electromagnetic wave is started and other equipments and communication link which have the electromagnetic wave in the location which reaches on the level beyond the 2nd adult threshold from the 1st threshold are performed.

[0028]

In the 2nd communication device and correspondence procedure of this invention, when other equipments check that the electromagnetic wave of the level beyond the 1st threshold does not exist and start the output of an electromagnetic wave, although data are acquired, the electromagnetic wave of the level beyond the 2nd adult threshold is needed from the 1st threshold.

[0029]

[Embodiment of the Invention]

Drawing 1 shows the example of a configuration of the gestalt of 1 operation of the communication system (a system means the thing object which two or more equipments combined logically, and it does not ask whether the equipment of each configuration is in the same case) which applied this invention.

[0030]

In drawing 1 , communication system consists of three NFC communication devices 1, 2, and 3. the NFC communication device 1 thru/or 3 -- each can perform now the contiguity communication link (NFC (Near Field Communication)) by electromagnetic induction which used the subcarrier of a single frequency among other NFC

communication devices.

[0031]

Here, as a frequency of the subcarrier which the NFC communication device 1 thru/or 3 use, 13.56 etc.MHz of an ISM (Industrial Scientific Medical) band etc. is employable, for example.

[0032]

Moreover, the communication link which means, and the equipments (case) which communicate contact and performs the communication link from which the distance of the equipments with which a contiguity communication link communicates is set to less than several 10cm, and becomes possible is also included.

[0033]

in addition, a thing employable as an IC card system which uses one or more [other] as an IC card while the communication system of drawing 1 makes reader/writer the NFC communication device 1 thru/or 1 or more [of 3] -- of course — the NFC communication device 1 thru/or 3 — it is also possible to adopt each as communication system, such as PDA (Personal Digital Assistant), PC (Personal Computer), a cellular phone, a wrist watch, and a pen. That is, the NFC communication device 1 thru/or 3 are equipment which performs a contiguity communication link, and is not limited to an IC card, reader/writer, etc. of IC card system.

[0034]

The NFC communication device 1 thru/or 3 have two descriptions that the communication link by the two communicate modes is possible to the 1st, and that the data transmission by two or more transmission rates is possible to the 2nd.

[0035]

There are the passive mode and the active mode as the two communicate modes. When it takes notice of the communication link between the NFC communication device 1 thru/or the NFC communication devices 1 and 2 of 3 now, in the passive mode The NFC communication device 1 which is one NFC communication device of the NFC communication devices 1 and 2 like the conventional IC card system mentioned above Data are transmitted to the NFC communication device 2 which is a NFC communication device of another side by modulating the electromagnetic wave (corresponding subcarrier) which self generates. The NFC communication device 2 By carrying out the load modulation of the electromagnetic waye (corresponding subcarrier) which the NFC communication device 1 generates, data are transmitted to the NFC communication device 1.

[0036]

On the other hand, in the active mode, all of the NFC communication devices 1 and 2 transmit data by modulating the electromagnetic wave (corresponding subcarrier) which self generates.

[0037]

When performing the contiguity communication link by electromagnetic induction here, an electromagnetic wave is outputted first, a communication link is started, and the equipment which has the communicative leadership so to speak is called an initiator. An initiator transmits a command to a communications partner, and although the communications partner is the form where the response to the command is returned and a contiguity communication link is performed, it calls a target the communications partner which returns the response to the command from an initiator.

[0038]

For example, supposing the NFC communication device 1 starts the output of an electromagnetic wave and starts the communication link with the NFC communication device 2 now, as shown in drawing 2 and drawing 3 , the NFC communication device 1 will serve as an initiator, and the NFC communication device 2 will serve as a target.

[0039]

And the NFC communication device 1 which is an initiator as shown in drawing 2 in the passive mode outputs an electromagnetic wave continuously, and while the NFC communication device 1 transmits data to the NFC communication device 2 which is a target by modulating the electromagnetic wave which self is outputting, the NFC communication device 2 transmits data to the NFC communication device 1 by carrying out the load modulation of the electromagnetic wave which the NFC communication device 1 which is an initiator is outputting.

[0040]

On the other hand, in the active mode, as shown in drawing 3 , the NFC communication device 1 which is an initiator transmits data to the NFC communication device 2 which is a target by starting the output of an electromagnetic wave in person and modulating the electromagnetic wave, when self transmits data. And the NFC communication device 1 suspends the output of an electromagnetic wave after transmitting termination of data. When self transmits data, and the NFC communication device 2 which is a target also starts the output of an electromagnetic wave in person and modulates the electromagnetic wave, data are transmitted to the NFC communication device 2 which is a target. And the NFC communication device 2 suspends the output of an electromagnetic wave after transmitting termination of data.

[0041]
In addition, the NFC communication device 1 thru/or 3 mention later about the 2nd focus that the data transmission by two or more transmission rates is possible.
[0042]
Moreover, although communication system is constituted from drawing 1 by three NFC communication devices 1 thru/or 3, the NFC communication device which constitutes communication system may not be limited to three, and may be 2 or 4 or more. Furthermore, communication system can also be constituted including an IC card, reader/writer, etc. which constitute other, for example, the conventional IC, card systems [communication device / NFC].
[0043]
Next, drawing 4 shows the example of a configuration of the NFC communication device 1 of drawing 1 . In addition, since other NFC communication devices 2 and 3 of drawing 1 as well as the NFC communication device 1 of drawing 4 are constituted, the explanation is omitted.
[0044]
The antenna 11 constitutes the coil of a closed loop, is that the current which flows in this coil changes, and outputs an electromagnetic wave. Moreover, a current flows at an antenna 11 because the magnetic flux which passes along the coil as an antenna 11 changes.
[0045]
A receive section 12 receives the current which flows at an antenna 11, performs alignment and detection, and outputs to the recovery section 13. The recovery section 13 restores to the signal supplied from a receive section 12, and supplies it to the decoding section 14. The decoding section 14 decodes the Manchester code as a signal supplied from the recovery section 13 etc., and supplies the data obtained as a result of the decoding to the data-processing section 15.
[0046]
The data-processing section 15 performs predetermined processing based on the data supplied from the decoding section 14. Moreover, the data-processing section 15 supplies the data which should be transmitted to other equipments to the encoding section 16.
[0047]
The encoding section 16 encodes the data supplied from the data-processing section 15 to a Manchester code etc., and supplies them to the selection section 17. The selection section 17 chooses either the modulation section 19 or the load modulation sections 20, and outputs the signal supplied to the selected one of it from the encoding section 16.
[0048]
Here, the selection section 17 chooses the modulation section 19 or the load modulation section 20 according to control of a control section 21. The communicate mode is the passive mode, and a control section 21 makes the load modulation section 20 choose it as the selection section 17, when the NFC communication device 1 serves as a target. Moreover, a control section 21 makes the modulation section 19 choose it as the selection section 17, when the communicate mode is the active mode, or when the communicate mode is the passive mode and the NFC communication device 1 serves as an initiator. Therefore, although the communicate mode is the passive mode and the signal which the encoding section 16 outputs is supplied to the load modulation section 20 through the selection section 17 in the case where the NFC communication device 1 serves as a target, it is supplied to the modulation section 19 through the selection section 17 in other cases.
[0049]
 electromagnetic wave output section 18 passes the current for making the subcarrier (electromagnetic wave) of a single predetermined frequency emit from an antenna 11 at an antenna 11. The electromagnetic wave output section 18 modulates the modulation section 19 according to the signal to which the subcarrier as a current passed at an antenna 11 is supplied from the selection section 17. Thereby, from an antenna 11, the electromagnetic wave on which the data-processing section 15 modulated the subcarrier according to the data outputted to the encoding section 16 is emitted.
[0050]
The load modulation section 20 changes the impedance when seeing the coil as an antenna 11 from the exterior according to the signal supplied from the selection section 17. When other equipments output the electromagnetic wave as a subcarrier, RF field (field) is formed in the perimeter of an antenna 11, and the impedance when seeing the coil as an antenna 11 changes, RF field around an antenna 11 also changes. The subcarrier as an electromagnetic wave which other equipments are outputting is modulated by this according to the signal supplied from the selection section 17, and the data which the data-processing section 15 outputted to the encoding section 16 are transmitted to other equipments which are outputting the electromagnetic wave.
[0051]
Here, as a modulation technique in the modulation section 19 and the load modulation section 20, amplitude modulation (ASK (Amplitude Shift Keying)) is employable, for

example. However, it is not limited to ASK and the modulation technique in the modulation section 19 and the load modulation section 20 can adopt PSK (Phase Shift Keying), and QAM (Quadrature Amplitude Modulation) and others. Moreover, what is necessary is not to be limited to numeric values, such as 8% to 30%, 50%, and 100 etc.%, about the modulation factor of the amplitude, and just to choose a suitable thing.

[0052]

A control section 21 controls each block which constitutes the NFC communication device 1. A power supply section 22 supplies a power source required for each block which constitutes the NFC communication device 1. In addition, since drawing becomes complicated, the illustration showing controlling each block whose control section 21 constitutes the NFC communication device 1 by drawing 4 of a line, and illustration of the line by which a power supply section 22 means supplying a power source in each block which constitutes the NFC communication device 1 have been omitted.

[0053]

A detecting element 23 detects whether the current which flows at an antenna 11 is received like a receive section 12, and the electromagnetic wave of the level beyond the predetermined threshold supplied from the threshold setting section 24 (flux density) is received by the antenna 11 based on the current.

[0054]

The threshold setting section 24 sets up the threshold of the level of the electromagnetic wave which a detecting element 23 is made to detect, and supplies it to a detecting element 23. In addition, the threshold setting section 24 can set up now two thresholds (the subcarrier output control decision flux density TH1 mentioned later and operating-limits subcarrier flux density TH2), and a detecting element 23 detects the electromagnetic wave of the level beyond the threshold which the threshold setting section 24 of the two thresholds sets up. However, the NFC communication device 1 prepares and constitutes a detecting element 25 further, makes a detecting element 23 detect the electromagnetic wave of the level beyond one threshold of the two thresholds, and can make a detecting element 25 detect the electromagnetic wave of the level beyond the threshold of another side, as the dotted line other than a detecting element 23 shows drawing 4 .

[0055]

In the above-mentioned case, in the decoding section 14 and the encoding section 16, the Manchester code adopted by the above-mentioned type C was processed here, but in the decoding section 14 and the encoding section 16, process is able to choose one from two or more kinds of signs, such as not only a Manchester code but modification DOMIRA adopted by Type A, NRZ adopted by Type C, and to make it.

[0056]

Next, drawing 5 shows the example of a configuration of the recovery section 13 of drawing 4 .

[0057]

At drawing 5 , the recovery section 13 consists of the recovery section 321 of N individual which are the 31 or 2 or more selection sections thru/or 32 Ns, and the selection section 33.

[0058]

According to control of a control section 21 (drawing 4), while being the recovery section 321 of N individual thru/or 32Ns, from from, the selection section 31 chooses 32n (n= 1, 2, ..., N) of one recovery section, and supplies the signal which a receive section 12 outputs to 32n of the selected recovery section.

[0059]

32n of recovery sections restores to the signal transmitted at the n-th transmission rate, and they supply it to the selection section 33. Here, 32n of recovery sections and 32n [of recovery sections]' (n!=n') restore to the signal transmitted at a different transmission rate. Therefore, the recovery section 13 of drawing 5 can restore now to the signal transmitted at the transmission rate as N of the 1st thru/or ** a Nth. In addition, as a transmission rate as N, more nearly high-speed 424kbps(es) besides 106kbps(es) mentioned above and 212kbps, 848kbps, etc. are employable, for example. That is, the transmission rate already adopted in the contiguity communication link of the existing IC card system etc. and the other transmission rate can be included in the transmission rate as N.

[0060]

According to control of a control section 21, while being the recovery section 321 of N individual thru/or 32Ns, from from, the selection section 33 chooses 32n of one recovery section, and supplies the recovery output obtained in 32n of the recovery section to the decoding section 14.

[0061]

A control section 21 (drawing 4) makes the selection section 31 make sequential selection of the recovery section 321 of N individual thru/or the 32 Ns, and, thereby, makes it recover the recovery section 321 thru/or 32Ns of signals supplied through the selection section 31 from a receive section 12 to each in the recovery section 13 constituted as mentioned above. And a control section 21 recognizes 32n of recovery

sections which were able to recover normally the signal supplied through the selection section 31 from the receive section 12, and controls the selection section 33 to choose the output of 32n of the recovery section. The selection section 33 chooses 32n of recovery sections according to control of a control section 21, and, thereby, the normal recovery output obtained in 32n of recovery sections is supplied to the decoding section 14.

[0062]

Therefore, in the recovery section 13, it can restore to the signal transmitted at the transmission rate of the arbitration of the transmission rates as N.

[0063]

In addition, only when it is able to get over normally, a recovery output is outputted, nothing is outputted, it can twist (for example, it becomes high impedance), and the recovery section 321 thru/or 32 Ns can be made like, when it is not able to get over normally. In this case, the selection section 33 takes the recovery section 321 thru/or an OR with an outputs [all] of 32 Ns, and should just output it to the decoding section 14.

[0064]

Next, drawing 6 shows the example of a configuration of the modulation section 19 of drawing 4 .

[0065]

At drawing 6 , the modulation section 19 consists of the modulation section 421 of N individual which are the 41 or 2 or more selection sections thru/or 42 Ns, and the selection section 43.

[0066]

According to control of a control section 21 (drawing 4), while being the modulation section 421 of N individual thru/or 42Ns, from from, the selection section 41 chooses 42n (n= 1, 2, ..., N) of one modulation section, and supplies the signal which the selection section 17 (drawing 4) outputs to 42n of the selected modulation section.

[0067]

42n of modulation sections is modulated through the selection section 43 according to the signal to which the subcarrier as a current which flows at an antenna 11 is supplied from the selection section 41 so that transmission of data may be performed at the n-th transmission rate. Here, 42n of modulation sections and 42n [of modulation sections]' (n!=n') modulate a subcarrier at a different transmission rate. Therefore, the modulation section 19 of drawing 6 can transmit data now at the transmission rate as N of the 1st thru/or ** a Nth. In addition, as a transmission rate as N, the same transmission rate as the ability to restore to the recovery section 13 of drawing 5 is employable, for example.

[0068]

According to control of a control section 21, while being the modulation section 421 of N individual thru/or 42Ns, from from, the selection section 43 chooses the 42n of the same modulation sections as the selection section 41 choosing, and connects electrically 42n of the modulation section, and an antenna 11.

[0069]

A control section 21 (drawing 4) makes the selection section 41 make sequential selection of the modulation section 421 of N individual thru/or the 42 Ns, and, thereby, makes it modulate 42Ns of subcarriers as a current which flow at an antenna 11 through the selection section 43 in the modulation section 19 constituted as mentioned above according to the modulation section 421 thru/or the signal supplied to each from the selection section 41.

[0070]

Therefore, in the modulation section 19, a subcarrier can be modulated and data can be transmitted so that data may be transmitted at the transmission rate of the arbitration of the transmission rates as N.

[0071]

In addition, since it is constituted like the modulation section 19 of drawing 6 , the load modulation section 20 of drawing 4 omits the explanation.

[0072]

As mentioned above, in the NFC communication device 1 thru/or 3, while modulating a subcarrier to the signal of the data to which it is transmitted at the transmission rate of either of the transmission rates as N, it can restore to the signal of the data transmitted at the transmission rate of either of the transmission rates as N. And as mentioned above, the transmission rate already adopted in the contiguity communication link of the existing IC card systems (FeliCa method etc.) etc. and the other transmission rate can be included in the transmission rate as N, for example. Therefore, according to the NFC communication device 1 thru/or 3, between each, data can be exchanged at any transmission rate of the transmission rate as the N. Furthermore, according to the NFC communication device 1 thru/or 3, data can be exchanged at the transmission rate which the IC card and reader/writer have adopted also between the IC cards and reader/writers which constitute the existing IC card system.

[0073]

And even if it, as a result, introduces the NFC communication device 1 thru/or 3 into the service as which the existing contiguity communication link is adopted, a user cannot do derangement etc., therefore the installation can be performed easily. Furthermore, the NFC communication device 1 thru/or 3 can be easily introduced also into the service as which the contiguity communication link by the high-speed data rate it is expected to be to appear in the future is adopted, aiming at coexistence with the existing contiguity communication link.

[0074]

Moreover, in the NFC communication device 1 thru/or 3, since the data transmission in the active mode in which data are transmitted when self besides the passive mode adopted by the conventional contiguity communication link outputs an electromagnetic wave is possible, even if it does not mind other equipments, such as reader/writer, data can be exchanged directly.

[0075]

Next, drawing 7 shows other examples of a configuration of the recovery section 13 of drawing 4 . In addition, about the case in drawing 5 , and the corresponding part, the same sign is attached among drawing, and, below, the explanation is omitted suitably. That is, the recovery section 13 of drawing 7 is fundamentally constituted similarly with the case [the selection section 31 is not formed and also] in drawing 5 .

[0076]

That is, to the recovery section 321 thru/or 32 Ns, the signal which a receive section 12 outputs with the gestalt of operation of drawing 7 is supplied to coincidence, and the signal from a receive section 12 restores to it by the recovery section 321 thru/or 32Ns at coincidence. And a control section 21 recognizes 32n of recovery sections which were able to restore to the signal from a receive section 12 normally, and controls the selection section 33 to output 32n of the recovery section. The selection section 33 chooses 32n of recovery sections according to control of a control section 21, and, thereby, the normal recovery output obtained in 32n of recovery sections is supplied to the decoding section 14.

[0077]

In addition, it is necessary to make recovery actuation always perform to the recovery section 321 thru/or 32 Ns with the gestalt of operation of drawing 7 . On the other hand, with the gestalt of operation of drawing 5 , recovery actuation can be made to be able to perform only to what is chosen as the selection section 31 the recovery section 321 thru/or of the 32 Ns, and other things can stop actuation. Therefore, from a viewpoint which saves the power consumption of equipment, the configuration of drawing 5 is more advantageous than drawing 7 . From a viewpoint which obtains a normal recovery output at an early stage on the other hand, the configuration of drawing 7 is more advantageous than drawing 5 .

[0078]

Next, drawing 8 shows the example of a configuration of further others of the recovery section 13 of drawing 4 .

[0079]

At drawing 8 , the recovery section 13 consists of the adjustable rate recovery section 51 and a rate detecting element 52.

[0080]

The adjustable rate recovery section 51 restores to the signal supplied from a receive section 12 as a signal of the transmission rate according to the directions from the rate detecting element 52, and supplies the recovery result to the decoding section 14. The rate detecting element 52 detects the transmission rate of the signal supplied from a receive section 12, and it directs it in the adjustable rate recovery section 51 so that it may restore to the signal of the transmission rate.

[0081]

In the recovery section 51 constituted as mentioned above, the signal which a receive section 12 outputs is supplied to the adjustable rate recovery section 51 and the rate detecting element 52. The rate detecting element 52 is directed in the adjustable rate recovery section 51 so that the transmission rate of the signal supplied from a receive section 12 may detect any of the transmission rates as N of the 1st thru/or ** a Nth they are and may restore to the signal of the transmission rate. And the adjustable rate recovery section 51 restores to the signal supplied from a receive section 12 as a signal of the transmission rate according to the directions from the rate detecting element 52, and supplies the recovery result to the decoding section 14.

[0082]

Next, each of NFC communication device 1 thru/or 3 can become the initiator which outputs an electromagnetic wave first and starts a communication link. Furthermore, in the active mode, the NFC communication device 1 thru/or 3 output an electromagnetic wave in person, when becoming an initiator, or when becoming a target.

[0083]

When two or more [of them] output an electromagnetic wave to coincidence, it becomes impossible therefore, to communicate by collision (collision) arising in the condition that the NFC communication device 1 thru/or 3 are close.

[0084]
the NFC communication device 1 thru/or 3 -- only when it does not detect and exist [whether the electromagnetic wave (RF field to depend) from other equipments exists, and], each starts the output of an electromagnetic wave and, thereby, prevents collision. [then,] Here, in this way, only when it does not detect and exist [whether the electromagnetic wave from other equipments exists, and], the processing which starts the output of an electromagnetic wave is called RFCA (RF Collision Avoidance) processing from the purpose of preventing collision.
[0085]
There are two, the initial RFCA processing which the NFC communication device (the NFC communication device 1 thru/or 1 or more [Drawing 1 / of 3]) which is going to serve as an initiator performs first, and the response RFCA processing performed whenever the NFC communication device which starts the output of an electromagnetic wave during a communication link with the active mode tends to carry out the initiation, in RFCA processing. Only when it does not detect and exist [whether the electromagnetic wave by other equipments exists, and] before starting the output of an electromagnetic wave even if it is initial RFCA processing and is response RFCA processing, the point of starting the output of an electromagnetic wave is the same. However, by initial RFCA processing and response RFCA processing, since existence of the electromagnetic wave by other equipments is no longer detected, the time amount to the timing which must start the output of an electromagnetic wave etc. differs.
[0086]
Then, with reference to drawing 9 , initial RFCA processing is explained first.
[0087]
Drawing 9 shows the electromagnetic wave by which an output is started by initial RFCA processing. In addition, in drawing 9 (the same is said of drawing 10 mentioned later), an axis of abscissa expresses time amount and an axis of ordinate expresses the level of the electromagnetic wave which a NFC communication device outputs.
[0088]
The NFC communication device which is going to serve as an initiator is detecting the electromagnetic wave by other equipments, and after only the output to the time amount TIRFG passes [the electromagnetic wave by other equipments] by starting the output of an electromagnetic wave when only time amount TIDT+nxTRFW is not detected continuously, it always starts transmission (Send Request) of data (a command is included).
[0089]
Here, TIDT in time amount TIDT+nxTRFW is called initial delay time amount, and if it is expressing the frequency of a subcarrier with fc, an adult value will be adopted from 4096/fc, for example. n is or more 0 three or less integer, and is generated using a random number. TRFW is called RF latency time, for example, 512/fc is adopted. Time amount TIRFG is called an initial guard time, for example, an adult value is adopted from 5ms.
[0090]
In addition, reduction of possibility of starting the output of an electromagnetic wave is achieved to the timing that two or more NFC communication devices are the same, by adopting n which is a random number as time amount TIDT+nxTRFW by which an electromagnetic wave must not be detected.
[0091]
When a NFC communication device starts the output of an electromagnetic wave by initial RFCA processing, the NFC communication device serves as an initiator, but when the active mode is set up as the communicate mode at that time, the NFC communication device used as an initiator suspends the output of an electromagnetic wave, after ending transmission of own data. On the other hand, as the communicate mode, when the passive mode is set up, the NFC communication device used as an initiator continues the output of the electromagnetic wave started by initial RFCA processing as it is until the communication link with a target is completed completely.
[0092]
Next, drawing 10 shows the electromagnetic wave by which an output is started by response RFCA processing.
[0093]
The NFC communication device which is going to output an electromagnetic wave in the active mode detects the electromagnetic wave by other equipments, and after only the output to the time amount TARFG passes [the electromagnetic wave by other equipments] by starting the output of an electromagnetic wave when only time amount TADT+nxTRFW is not detected continuously, it starts transmission (Send Responsese) of data.
[0094]
Here, n and TRFW in time amount TADT+nxTRFW are the same as that of the case in initial RFCA processing of drawing 9 . Moreover, TADT in time amount TADT+nxTRFW is called an active delay time, for example, the value below 2559-/fc is adopted more than 768-/fc. Time amount TARFG is called an active guard time, for example, an

adult value is adopted from 1024/fc.

[0095]

In order to start the output of an electromagnetic wave by initial RFCA processing so that clearly from drawing 9 and drawing 10 , an electromagnetic wave must not exist between the initial delay time amount TIDT at least, and in order to start the output of an electromagnetic wave by response RFCA processing, an electromagnetic wave must not exist between the active delay times TADT at least.

[0096]

And the condition that an electromagnetic wave does not exist rather than the case where it is going to output an electromagnetic wave during a communication link with the active mode from the initial delay time amount4096/fc when a NFC communication device tends to become an initiator, since the active delay time TADT is a value below 2559-/fc more than 768-/fc to TIDT being an adult value is the long duration need. Conversely, if it says, when a NFC communication device tends to output an electromagnetic wave during a communication link with the active mode, after being in the condition that an electromagnetic wave does not exist from the case where it is going to become an initiator, an electromagnetic wave must be outputted so much for between to a dish. This is based on the following reasons.

[0097]

That is, when a NFC communication device communicates in the active mode, one NFC communication device outputs an electromagnetic wave in person, transmits data, and suspends the output of an electromagnetic wave after that. And the NFC communication device of another side starts the output of an electromagnetic wave, and data are transmitted. Therefore, in the communication link in the active mode, any NFC communication device may have suspended the output of an electromagnetic wave. for this reason, when a NFC communication device tends to become an initiator, in order to check that the communication link in the active mode is not performed around that NFC communication device, the perimeter of the NFC communication device which is going to become an initiator is enough in other equipments not outputting the electromagnetic wave — it is necessary to carry out a time amount check

[0098]

On the other hand, in the active mode, as mentioned above, when an initiator outputs an electromagnetic wave, data are transmitted to a target. And a target transmits data to an initiator by starting the output of an electromagnetic wave, after an initiator suspends the output of an electromagnetic wave. Then, after, as for an initiator, a target suspends the output of an electromagnetic wave, by starting the output of an electromagnetic wave, data are transmitted to an initiator and data are hereafter exchanged between an initiator and a target similarly.

[0099]

Therefore, around the initiator which is communicating the active mode, and a target When the NFC communication device which is going to serve as an initiator exists, after one side of the initiators and targets which are communicating the active mode suspends the output of an electromagnetic wave If time amount until another side starts the output of an electromagnetic wave is long, since an electromagnetic wave does not exist in the meantime, the NFC communication device which is going to serve as an initiator starts the output of an electromagnetic wave by initial RFCA processing. In this case, the communication link in the active mode currently performed previously will be barred.

[0100]

For this reason, after being in the condition that an electromagnetic wave does not exist, he is trying to have to output an electromagnetic wave for between to a dish so much in the response RFCA processing performed during the communication link in the active mode.

[0101]

Next, as drawing 9 explained, by initial RFCA processing, the NFC communication device which is going to become an initiator starts the output of an electromagnetic wave, and performs transmission of data after that. Although the NFC communication device which is going to become an initiator is starting the output of an electromagnetic wave, and serves as an initiator and the NFC communication device which exists in the location close to the initiator serves as a target, an initiator must specify the target which exchanges the data, in order to carry out an exchange of a target and data. For this reason, an initiator requires NFCID (NFC Identification) as information which specifies each target from one or more targets which exist in the location close to that initiator, after starting the output of an electromagnetic wave by initial RFCA processing. And the target which exists in the location close to an initiator transmits NFCID which specifies self to an initiator according to the demand from an initiator.

[0102]

Although an initiator specifies a target and exchanges data between the specified target by NFCID transmitted from a target as mentioned above, the processing whose initiator specifies the target which exists in the perimeter (approaching location) by

the NFCID is called SDD (Single Device Detection) processing.

[0103]

Here, in SDD processing, although an initiator requires NFCID of a target, this demand is performed, when an initiator transmits the frame called a polling request frame. If a polling request frame is received, a target will determine own NFCID with a random number, and will transmit the frame called the polling response frame which has arranged the NFCID, for example. An initiator is receiving the polling response frame transmitted from a target, and recognizes NFCID of a target.

[0104]

By the way, when an initiator requires the NFCID from the target of the perimeter and two or more targets exist in the perimeter of an initiator, NFCID may be transmitted to 2, as mentioned above coincidence of two or more of the targets. In this case, NFCID transmitted from those two or more targets cannot carry out collision, and an initiator cannot recognize that NFCID that carried out collision.

[0105]

Then, SDD processing is performed by the approach using a time slot in order to avoid the collision of NFCID if possible.

[0106]

That is, drawing 11 shows the sequence of the SDD processing performed by the approach which used the time slot. In addition, in drawing 11 , five target #1, #2, #3, #4, and #5 shall have existed in the perimeter of an initiator.

[0107]

In SDD processing, although an initiator transmits a polling request frame, only the predetermined time amount Td is set after completion of the transmission, and the time slot of the width of face of the predetermined time amount Ts is prepared. In addition, time amount Td is set to 512x64/fc, and time amount Ts as width of face of a time slot is set to 256x64/fc. Moreover, a time slot is specified by giving the sequential number (integer) from [from what is preceded most] 0 to for example, a time amount target.

[0108]

Although four, time-slot #0, #1, #2, and #3, are shown, a time slot can be prepared to 16 here at drawing 11 . An initiator specifies the number TSN of the time slots prepared to a certain polling request frame, it is included in a polling request frame, and is transmitted to a target.

[0109]

A target receives the polling request frame transmitted from an initiator, and recognizes the number TSN of the time slots arranged at the polling request frame. Furthermore, a target generates the integer R of the range of more than 0TSN-1 with a random number, is the timing of time-slot #R specified for the integer R, and transmits the polling response frame which has arranged own NFCID.

[0110]

As mentioned above, since a target determines the time slot as timing which transmits a polling response frame with a random number, the timing to which two or more targets transmit a polling response frame will vary, and, thereby, if possible, it can avoid the collision of the polling response frames which two or more targets transmit.

[0111]

In addition, in a target, even if a random number determines the time slot as timing which transmits a polling response frame, the time slot to which two or more targets transmit a polling response frame may be in agreement, and, thereby, the collision of a polling response frame may arise. In time-slot #0, in time-slot #1, the polling response frame of target #2 is transmitted [in / in the polling response frame of target #1 and #3 / time-slot #3] for the polling response frame of target #5, respectively, and the polling response frame of target #1 and #3 has produced [in / in the polling response frame of target #4 / time-slot #2] collision with the gestalt of operation of drawing 11 .

[0112]

In this case, an initiator cannot receive normally the polling response frame of target #1 and #3 which has produced collision. Therefore, again, an initiator transmits a polling request frame and, thereby, requires transmission of the polling response frame by which each NFCID has been arranged from target #1 and #3. target #1 which is in the perimeter in an initiator hereafter thru/or #5 — transmission of the polling request frame by the initiator and transmission of the polling response frame by the target are repeatedly performed until it can recognize all NFCID(s).

[0113]

In addition, when an initiator transmits a polling request frame again, if [all target #1 thru/or #5] a polling response frame is returned, polling response frames may start collision again. Then, in a target, when a polling request frame is again received so much for time amount as a dish after receiving a polling request frame from an initiator, the polling request can be disregarded, for example. However, since an initiator cannot recognize that NFCID of target #1 and #3 about target #1 which has produced the collision of a polling response to the polling request frame transmitted first with the gestalt of operation of drawing 11 in this case, and #3, an exchange of the data

between target #1 or #3 can be performed.

[0114]

Then, a polling response frame is received normally, and an initiator removes temporarily from the candidate for a communication link, and can be prevented from returning the polling response frame as a response to a polling request frame by this about target #2 which have recognized the NFCID, #4, and #5, so that it may mention later. In this case, returning a polling response frame is set only to target #1 which has not recognized NFCID by transmission of the first polling request frame, and #3 to the polling request frame for the second time which an initiator transmits. therefore -- while making small possibility that polling response frames will start collision in this case -- target #1 thru/or #5 -- it becomes possible to recognize all NFCID(s).

[0115]

Moreover, a target will determine own NFCID with a random number here, if a polling request frame is received as mentioned above (generation). For this reason, from a different target, the same NFCID is arranged at a polling response frame, and may be transmitted to an initiator. When the polling response frame by which the same NFCID has been arranged is received, a polling request frame can be made to transmit to an initiator again like the case where for example, polling response frames start collision, in a different time slot in an initiator.

[0116]

Here, as mentioned above, also between the IC cards and reader/writers which constitute the existing IC card system, a NFC communication device is the transmission rate which the IC card and reader/writer have adopted, and can exchange data. Now, when a target is the IC card of the existing IC card system, SDD processing is performed as follows, for example.

[0117]

That is, the IC card an initiator starts the output of an electromagnetic wave by initial RFCA processing, and is [IC card] a target acquires a power source from the electromagnetic wave, and starts processing. That is, since a target is the IC card of the existing IC card system in now, the power source for operating is generated from the electromagnetic wave which an initiator outputs.

[0118]

After a target acquires a power source and is in the condition that it can operate, the preparations with which the longest also receives a polling request frame within 2 seconds are made, and it waits to transmit a polling request frame from an initiator, for example.

[0119]

On the other hand, an initiator can transmit a polling request frame regardless of whether the preparation which receives a polling request frame in a target was completed.

[0120]

When the polling request frame from an initiator is received, as mentioned above, a target is the timing of a predetermined time slot and transmits a polling response frame to an initiator. When normal reception of the polling response frame from a target is able to be carried out, an initiator recognizes NFCID of the target, as mentioned above. On the other hand, an initiator can transmit a polling request frame again, when normal reception of the polling response frame from a target is not able to be carried out.

[0121]

In addition, since a target is the IC card of the existing IC card system in now, the power source for operating is generated from the electromagnetic wave which an initiator outputs. For this reason, an initiator continues until the communication link with a target ends completely the output of the electromagnetic wave started by initial RFCA processing.

[0122]

Next, a communication link is performed by the NFC communication device by what (it returns) an initiator transmits a command to a target and a target transmits the response to the command from an initiator for.

[0123]

Then, drawing 12 shows the command which an initiator transmits to a target, and the response which a target transmits to an initiator.

[0124]

In drawing 12 , that the alphabetic character of REQ is described to be after the underbar (_) expresses a command, and that the alphabetic character of RES is described to be after the underbar (_) expresses a response. With the gestalt of operation of drawing 12 , as a command, six kinds, ATR_REQ, WUP_REQ, PSL_REQ, DEP_REQ, DSL_REQ, and RLS_REQ, are prepared, and six kinds, ATR_RES, WUP_RES, PSL_RES, DEP_RES, DSL_RES, and RLS_RES, are prepared like the command also as a response to a command. Since an initiator transmits a command (request) to a target and a target transmits the response corresponding to the command to an initiator as mentioned above, a command is transmitted by the initiator and a response is transmitted with a target.

[0125]
Command ATR_REQ is transmitted to a target, when requiring the attribute of a target, while an initiator tells an own attribute (specification) to a target. Here, as an attribute of an initiator or a target, there is a transmission rate of the data which can transmit and receive the initiator or target etc. In addition, to command ATR_REQ, NFCID which specifies its initiator besides the attribute of an initiator is arranged, and a target recognizes the attribute and NFCID of an initiator by receiving command ATR_REQ.
[0126]
Response ATR_REQ is transmitted to an initiator as a response to the command ATR_REQ, when a target receives command ATR_REQ. An attribute, NFCID, etc. of a target are arranged at response ATR_REQ.
[0127]
In addition, all the transmission rates of the data which can transmit and receive an initiator and a target can be included in the information on the transmission rate as an attribute arranged at command ATR_REQ or response ATR_REQ. In this case, between an initiator and a target, only by the exchange of command ATR_REQ and response ATR_REQ being performed once, the transmission rate which can transmit and receive a target can be recognized and, as for an initiator, a target can also recognize the transmission rate which can transmit and receive an initiator.
[0128]
Command WUP_REQ is transmitted when an initiator chooses the target which communicates. That is, although a target can be made into a DISEREKUTO (deselect) condition (condition which forbade transmission (response) of the data to an initiator) by transmitting command DSL_REQ mentioned later to a target from an initiator, command WUP_REQ dispels the DISEREKUTO condition, and when making a target into the condition of enabling transmission of the data to an initiator, it is transmitted. In addition, the target specified as command WUP_REQ by NFCID which NFCID of a target which dispels a DISEREKUTO condition is arranged and is arranged at the command WUP_REQ among the targets which received command WUP_REQ dispels a DISEREKUTO condition.
[0129]
Response WUP_RES is transmitted as a response to command WUP_REQ, when the target specified by NFCID arranged at the command WUP_REQ among the targets which received command WUP_REQ dispels a DISEREKUTO condition.
[0130]
Command PSL_REQ is transmitted when an initiator changes the communications parameter about the communication link with a target. Here, as a communications parameter, there is a transmission rate of the data exchanged between an initiator and a target etc., for example.
[0131]
The value of the communications parameter after modification is arranged at command PSL_REQ, and it is transmitted to a target from an initiator. A target receives command PSL_REQ and changes a communications parameter according to the value of the communications parameter arranged there. Furthermore, a target transmits response PSL_RES to command PSL_REQ.
[0132]
The data which command DEP_REQ is transmitted when an initiator transmits and receives data (the so-called live data) (data exchange between targets), and should be transmitted to a target there are arranged. The data which a target should transmit response DEP_RES as a response to command DEP_REQ, and should be transmitted there at an initiator are arranged. Therefore, data are transmitted to a target by command DEP_REQ from an initiator, and data are transmitted to an initiator from a target by response DEP_RES to the command DEP_REQ.
[0133]
Command DSL_REQ is transmitted when an initiator makes a target a DISEREKUTO condition. The target which received command DSL_REQ will transmit response DSL_RES to the command DSL_REQ, will be in a DISEREKUTO condition, and will not react to any commands other than command WUP_REQ henceforth (it stops returning a response).
[0134]
Command RLS_REQ is transmitted when an initiator ends the communication link with a target completely. The target which received command RLS_REQ transmits response RLS_RES to the command RLS_REQ, and ends the communication link with an initiator completely.
[0135]
Here, each of command DSL_REQ and RLS_REQ is common in that a target is released from the object of the communication link with an initiator. However, although the target released by command DSL_REQ will be in an initiator and the condition which can be communicated again by command WUP_REQ, the target released by command RLS_REQ will not be in an initiator and the condition which can be communicated, unless the exchange of the polling request frame mentioned above

and a polling response frame is performed between initiators. At this point, command DSL_REQ differs from RLS_REQ.

[0136]

In addition, the exchange of a command and a response can be performed by the transport layer.

[0137]

Next, the communications processing of a NFC communication device is explained with reference to the flow chart of drawing 13 .

[0138]

A NFC communication device judges first whether the electromagnetic wave by other equipments was detected in step S1, when starting a communication link.

[0139]

Here, in a NFC communication device (drawing 4), the control section 21 is supervising the detection result of the electromagnetic wave (the electromagnetic wave used with a NFC communication device, and electromagnetic wave with the same frequency band etc.) in a detecting element 23, and it is judged at step S1 based on the detection result whether the electromagnetic wave by other equipments was detected. Namely, in this case, the threshold setting section 24 of drawing 4 sets up as a threshold the subcarrier output control decision flux density TH1 explained by drawing 24 thru/or drawing 26 mentioned later, and supplies it to a detecting element 23. And a detecting element 23 detects with a subcarrier output control decision flux density [as a threshold supplied from the threshold setting section 24 / TH] of one or more level.

[0140]

In step S1, when judged with the electromagnetic wave by other equipments not having been detected, it progresses to step S2 and a NFC communication device processes processing of the initiator in the passive mode which sets the communicate mode as the passive mode or the active mode, and mentions it later, or the initiator in the active mode. And a NFC communication device repeats the same processing return and the following to step S1 after termination of the processing.

[0141]

Here, in step S2, the communicate mode of a NFC communication device may be set as any of the passive mode or the active modes, as mentioned above. However, when a target cannot turn into only a target in the passive modes, such as an IC card of the existing IC card system, at step S2, a NFC communication device needs to set the communicate mode as the passive mode, and needs to process the initiator in the passive mode.

[0142]

When it is judged with the electromagnetic wave by other equipments having been detected in step S1 on the other hand (i.e., when the electromagnetic wave by other equipments is detected around a NFC communication device), it progresses to step S3 and a NFC communication device judges whether the electromagnetic wave detected at step S1 is continue being detected.

[0143]

In step S3, when judged with an electromagnetic wave continuing being detected, it progresses to step S4 and a NFC communication device processes the target in the passive mode which sets the communicate mode as the passive mode, and mentions it later. Namely, it is the case which is continuing outputting the electromagnetic wave which started the output by initial RFCA processing by becoming the initiator in the passive mode, and a NFC communication device processes by other equipments with which the case where an electromagnetic wave is continuing being detected approaches for example, a NFC communication device serving as a target in the passive mode. And the same processing is repeated by step S1 return and the following after termination of the processing.

[0144]

Moreover, in step S3, when judged with an electromagnetic wave continuing being detected, it progresses to step S5 and a NFC communication device processes the target in the active mode which sets the communicate mode as the active mode, and mentions it later. That is, since other equipments with which the case where an electromagnetic wave is continuing being detected approaches for example, a NFC communication device are the cases which started the output of an electromagnetic wave by initial RFCA processing by becoming the initiator in the active mode, and suspended the output of the electromagnetic wave after that, they serve as a target in the active mode, and a NFC communication device processes. And the same processing is repeated by step S1 return and the following after termination of the processing.

[0145]

Next, with reference to the flow chart of drawing 14 , processing of the initiator in the passive mode by the NFC communication device is explained.

[0146]

In processing of the initiator in the passive mode, a NFC communication device starts the output of an electromagnetic wave in step S11 first. In addition, in step S1 of

above-mentioned drawing 13 , step S11 in processing of the initiator in this passive mode is performed, when an electromagnetic wave is not detected. That is, in step S1 of drawing 13 , a NFC communication device starts the output of an electromagnetic wave in step S11, when an electromagnetic wave is not detected. Therefore, processing of steps S1 and S11 is equivalent to above-mentioned initial RFCA processing.

[0147]

Then, it progresses to step S12, and a NFC communication device sets the variable n showing a transmission rate to 1 as initial value, and progresses to step S13. At step S13, a NFC communication device is the n-th transmission rate (suitably henceforth the n-th rate), transmits a polling request frame and progresses to step S14. At step S14, from other equipments, a NFC communication device is the n-th rate, and judges whether the polling response frame has been transmitted.

[0148]

In step S14, other equipments which approach for example, a NFC communication device when judged [that a polling response frame has not been transmitted and] from other equipments cannot perform a communication link at the n-th rate, but when the polling response frame to the polling request frame transmitted at the n-th rate does not come on the contrary, step S15 thru/or S17 are skipped, and it progresses to step S18.

[0149]

Moreover, when it is judged with the polling response frame having been transmitted at the n-th rate from other equipments in step S14, Namely, for example, other equipments close to a NFC communication device can perform a communication link at the n-th rate. When the polling response frame to the polling request frame transmitted at the n-th rate comes on the contrary, it progresses to step S15. A NFC communication device As a target in the passive mode, while recognizing other equipments which have returned the polling response frame by NFCID arranged in NFCID of the target at the polling response frame It recognizes that the target can communicate at the n-th rate.

[0150]

Here, if a NFC communication device recognizes that the target can communicate with NFCID of the target in the passive mode at the n-th rate in step S15, the transmission rate between the target is determined as the n-th rate (temporarily), and the target will communicate at the n-th rate, unless a transmission rate is changed by command PSL_REQ.

[0151]

Then, it progresses to step S16, and a NFC communication device transmits command DSL_REQ to the target (target in the passive mode) of NFCID recognized at step S15 at the n-th rate, thereby, it is changed into a DISEREKUTO condition and progresses to step S17 so that the target may not answer the polling request frame transmitted henceforth.

[0152]

At step S17, a NFC communication device receives response DSL_RES which the target made a DISEREKUTO condition by the command DSL_REQ returns to command DSL_REQ which transmitted at step S16, and progresses to step S18.

[0153]

In step S18, at step S13, a NFC communication device judges whether predetermined time amount passed, after transmitting a polling request frame at the n-th rate. Here, predetermined time amount in step S18 can be made into zero or more time amount.

[0154]

In step S18, after transmitting a polling request frame at the n-th rate by step S13, when it is still judged with predetermined time amount having not passed, step S13 thru/or processing of S18 are repeated by step S13 return and the following.

[0155]

Here, by repeating step S13 thru/or processing of S18, a NFC communication device can receive the polling response frame transmitted to the timing of a different time slot, as drawing 11 explained.

[0156]

On the other hand, after transmitting a polling request frame at the n-th rate by step S13, when it is judged with predetermined time amount having passed in step S18, it progresses to step S19 and judges whether a NFC communication device is equal to N whose variable n is the maximum. In step S19, when it judges that Variable n is not equal to Maximum N (i.e., when Variable n is under the maximum N), it progresses to step S20, and only 1 increments Variable n and, as for a NFC communication device, step S13 thru/or processing of S20 are repeated by step S13 return and the following in it.

[0157]

Here, while a NFC communication device is a transmission rate as N by repeating step S13 thru/or processing of S20 and transmitting a polling request frame, the polling response frame which comes by each transmission rate on the contrary is received.

[0158]

On the other hand, when it judges that Variable n is equal to Maximum N in step S19 (i.e., while transmitting a polling request frame, when a NFC communication device receives the polling response frame which comes by each transmission rate on the contrary at the transmission rate as N as N), it progresses to step S21 and, as for a NFC communication device, the communications processing (communications processing of the initiator in the passive mode) is performed as an initiator in the passive mode. Here, about the communications processing of the initiator in the passive mode, it mentions later.
[0159]
And after the communications processing of the initiator in the passive mode is completed, a NFC communication device progresses to S22 from step S21, suspends the output of the electromagnetic wave which started the output at step S11, and ends processing.
[0160]
Next, with reference to the flow chart of drawing 15 , processing of the target in the passive mode by the NFC communication device is explained.
[0161]
In processing of the target in the passive mode, first, in step S31, a NFC communication device sets the variable n showing a transmission rate to 1 as initial value, and progresses to step S32. At step S32, from other equipments used as the initiator in the passive mode, a NFC communication device is the n-th rate, and judges whether the polling request frame has been transmitted.
[0162]
In step S32, when judged [that a polling request frame has not been transmitted and] from the initiator in the passive mode (i.e., when other equipments close to for example, a NFC communication device cannot perform a communication link at the n-th rate and cannot transmit a polling request frame at the n-th rate), it progresses to step S33 and judges whether a NFC communication device is equal to N whose variable n is the maximum. In step S33, when it judges that Variable n is not equal to Maximum N (i.e., when Variable n is under the maximum N), it progresses to step S34, and only 1 increments Variable n and, as for a NFC communication device, step S32 thru/or processing of S34 are repeated by step S32 return and the following in it.
[0163]
Moreover, in step S33, when it judges that Variable n is equal to Maximum N, step S31 thru/or processing of S34 are repeated by step S31 return and the following. That is, step S31 thru/or processing of S34 are repeated here until the polling request frame transmitted in either of the transmission rates as N is receivable from the initiator in the passive mode.
[0164]
And in step S32, when judged with the polling request frame having been transmitted from the initiator in the passive mode (i.e., when a NFC communication device carries out normal reception of the polling request frame of the n-th rate), it progresses to step S35, and with a random number, a NFC communication device generates own NFCID and progresses to step S36 while determining the transmission rate between initiators as the n-th rate. At step S36, a NFC communication device transmits the polling response frame which has arranged own NFCID at the n-th rate, and progresses to step S37.
[0165]
Here, a NFC communication device communicates at the n-th rate, unless modification of a transmission rate is directed by transmitting command PSL_REQ from the initiator in the passive mode at step S36, after transmitting a polling response frame at the n-th rate.
[0166]
At step S37, a NFC communication device waits to transmit command DSL_REQ to step S37 from the initiator in return and the passive mode, when it judges [judging whether command DSL_REQ has been transmitted and not having been transmitted from the initiator in the passive mode, and].
[0167]
Moreover, in step S37, when judged with command DSL_REQ having been transmitted from the initiator in the passive mode (i.e., when a NFC communication device receives command DSL_REQ), it progresses to step S38, and a NFC communication device transmits response DSL_REQ to command DSL_REQ, will be in a DISEREKUTO condition, and will progress to step S39.
[0168]
At step S39, a NFC communication device ends processing, after performing the communications processing (communications processing of the target in the passive mode) and completing the communications processing of the target in the passive mode as a target in the passive mode. In addition, about the communications processing of the target in the passive mode, it mentions later.
[0169]
Next, with reference to the flow chart of drawing 16 , processing of the initiator in the active mode by the NFC communication device is explained.

[0170]
In processing of the initiator in the active mode, step S11 of processing of the initiator in the passive mode of drawing 14 thru/or the respectively same processing as the case in S21 are performed in step S51 thru/or S61. However, in processing of the initiator in the passive mode of drawing 14 , a NFC communication device continues outputting an electromagnetic wave until the processing is completed, but in processing of the initiator in the active mode, only when a NFC communication device transmits data, the points which output an electromagnetic wave differ.
[0171]
That is, in step S51, a NFC communication device starts the output of an electromagnetic wave.
In addition, in step S1 of above-mentioned drawing 13 , step S51 in processing of the initiator in this active mode is performed, when an electromagnetic wave is not detected. That is, in step S1 of drawing 13 , a NFC communication device starts the output of an electromagnetic wave in step S51, when an electromagnetic wave is not detected. Therefore, processing of steps S1 and S51 is equivalent to above-mentioned initial RFCA processing.
[0172]
Then, it progresses to step S52, and a NFC communication device sets the variable n showing a transmission rate to 1 as initial value, and progresses to step S53. At step S53, a NFC communication device is the n-th rate, it transmits a polling request frame, suspends the output of an electromagnetic wave (it is said suitably that RF off processing is performed hereafter), and progresses to step S54.
[0173]
Here, at step S53, a NFC communication device starts the output of an electromagnetic wave by above-mentioned active RFCA processing, before transmitting a polling request frame. However, when Variable n is 1 which is initial value, since the output of an electromagnetic wave is already started by the initial RFCA processing corresponding to processing of steps S1 and S51, it is not necessary by it to perform active RFCA processing.
[0174]
At step S54, from other equipments, a NFC communication device is the n-th rate, and judges whether the polling response frame has been transmitted.
[0175]
In step S54, other equipments which approach for example, a NFC communication device when judged [that a polling response frame has not been transmitted and] from other equipments cannot perform a communication link at the n-th rate, but when the polling response frame to the polling request frame transmitted at the n-th rate does not come on the contrary, step S55 thru/or S57 are skipped, and it progresses to step S58.
[0176]
Moreover, when it is judged with the polling response frame having been transmitted at the n-th rate from other equipments in step S54, Namely, for example, other equipments close to a NFC communication device can perform a communication link at the n-th rate. When the polling response frame to the polling request frame transmitted at the n-th rate comes on the contrary, it progresses to step S55. A NFC communication device As a target in the active mode, while recognizing other equipments which have returned the polling response frame by NFCID arranged in NFCID of the target at the polling response frame It recognizes that the target can communicate at the n-th rate.
[0177]
Here, if a NFC communication device recognizes that the target can communicate with NFCID of the target in the active mode at the n-th rate in step S55, the transmission rate between the target is determined as the n-th rate, and the target will communicate at the n-th rate, unless a transmission rate is changed by command PSL_REQ.
[0178]
Then, it progresses to step S56, and a NFC communication device starts the output of an electromagnetic wave by active RFCA processing, and transmits command DSL_REQ to the target (target in the active mode) of NFCID recognized at step S55 at the n-th rate.
Thereby, the target will be in the DISEREKUTO condition which does not answer the polling request frame transmitted henceforth. Then, a NFC communication device performs RF off processing, and progresses to S57 from step S56.
[0179]
At step S57, a NFC communication device receives response DSL_RES which the target made a DISEREKUTO condition by the command DSL_REQ returns to command DSL_REQ which transmitted at step S56, and progresses to step S58.
[0180]
In step S58, at step S53, a NFC communication device judges whether predetermined time amount passed, after transmitting a polling request frame at the n-th rate.
[0181]

In step S58, after transmitting a polling request frame at the n-th rate by step S53, when it is still judged with predetermined time amount having not passed, step S53 thru/or processing of S58 are repeated by step S53 return and the following.
[0182]
On the other hand, after transmitting a polling request frame at the n-th rate by step S53, when it is judged with predetermined time amount having passed in step S58, it progresses to step S59 and judges whether a NFC communication device is equal to N whose variable n is the maximum. In step S59, when it judges that Variable n is not equal to Maximum N (i.e., when Variable n is under the maximum N), it progresses to step S60, and only 1 increments Variable n and, as for a NFC communication device, step S53 thru/or processing of S60 are repeated by step S53 return and the following in it.
[0183]
Here, while a NFC communication device is a transmission rate as N by repeating step S53 thru/or processing of S60 and transmitting a polling request frame, the polling response frame which comes by each transmission rate on the contrary is received.
[0184]
When it judges that Variable n is equal to Maximum N, on the other hand in step S59, a NFC communication device at the transmission rate as N as N While transmitting a polling request frame, when the polling response frame which comes by each transmission rate on the contrary is received, it progresses to step S61. A NFC communication device As an initiator in the active mode, the communications processing (communications processing of the initiator in the active mode) is performed, and processing is ended after that. Here, about the communications processing of the initiator in the active mode, it mentions later.
[0185]
Next, with reference to the flow chart of drawing 17, processing of the target in the active mode by the NFC communication device is explained.
[0186]
In processing of the target in the active mode, step S31 of processing of the target in the passive mode of drawing 15 thru/or the respectively same processing as the case in S39 are performed in step S71 thru/or S79. However, although data are transmitted in processing of the target in the passive mode of drawing 15 when a NFC communication device carries out the load modulation of the electromagnetic wave which the initiator in the passive mode outputs, it differs in processing of the target in the active mode in that a NFC communication device outputs an electromagnetic wave in person, and data are transmitted.
[0187]
That is, in processing of the target in the active mode, step S31 of drawing 15 thru/or the respectively same processing as the case in S35 are performed in step S71 thru/or S75.
[0188]
And it progresses to step S76 after processing of step S75, and a NFC communication device starts the output of an electromagnetic wave by active RFCA processing, and transmits the polling response frame which has arranged own NFCID at the n-th rate. Furthermore, at step S76, a NFC communication device performs RF OFF processing, and progresses to step S77.
[0189]
Here, a NFC communication device communicates at the n-th rate, unless modification of a transmission rate is directed by transmitting command PSL_REQ from the initiator in the active mode at step S76, after transmitting a polling response frame at the n-th rate.
[0190]
At step S77, a NFC communication device waits to transmit command DSL_REQ to step S77 from the initiator in return and the active mode, when it judges [judging whether command DSL_REQ has been transmitted and not having been transmitted from the initiator in the active mode, and].
[0191]
Moreover, in step S77, when judged with command DSL_REQ having been transmitted from the initiator in the active mode (i.e., when a NFC communication device receives command DSL_REQ), it progresses to step S78, and a NFC communication device starts the output of an electromagnetic wave by active RFCA processing, and transmits response DSL_REQ to command DSL_REQ. Furthermore, at step S78, a NFC communication device performs RF OFF processing, will be in a DISEREKUTO condition, and will progress to step S79.
[0192]
At step S79, a NFC communication device ends processing, after performing the communications processing (communications processing of the target in the active mode) and completing the communications processing of the target in the active mode as a target in the active mode. In addition, about the communications processing of the target in the active mode, it mentions later.
[0193]

Next, with reference to the flow chart of drawing 18 and drawing 19 , the communications processing of the initiator in the passive mode in step S21 of drawing 14 is explained.

[0194]

In step S91, the NFC communication device which is the initiator in the passive mode chooses the equipment (suitably henceforth attention equipment) which communicates from the targets which have recognized NFCID at step S15 of drawing 14 , and progresses to step S92. At step S92, command WUP_REQ is transmitted to attention equipment and this cancels the DISEREKUTO condition of the attention equipment made into the DISEREKUTO condition by transmitting command DSL_REQ at step S16 of drawing 14 (it is suitably said for the Wake rise that it carries out hereafter).

[0195]

Then, attention equipment waits to transmit response WUP_RES to command WUP_REQ, and progresses to S93 from step S92, and a NFC communication device receives the response WUP_RES, and progresses to step S94. At step S94, a NFC communication device transmits command ATR_REQ to attention equipment. And attention equipment waits to transmit response ATR_RES to command ATR_REQ, and progresses to S95 from step S94, and a NFC communication device receives the response ATR_RES.

[0196]

Here, a NFC communication device and attention equipment recognize mutually the transmission rate with which a partner can communicate because a NFC communication device and attention equipment exchange command ATR_REQ by which an attribute is arranged as mentioned above, and response ATR_RES.

[0197]

Then, it progresses to S96 from step S95, and a NFC communication device transmits command DSL_REQ to attention equipment, and changes attention equipment into a DISEREKUTO condition. And attention equipment waits to transmit response DSL_RES to command DSL_REQ, and progresses to S97 from step S96, and a NFC communication device receives the response DSL_RES, and progresses to step S98.

[0198]

At step S98, it judges whether the NFC communication device chose all the targets that have recognized NFCID at step S15 of drawing 14 as attention equipment at step S91. In step S98, when a NFC communication device judges with there being a target which has not been chosen as attention equipment yet, to step S91, return and a NFC communication device are newly [one] of the targets which have not been chosen as attention equipment chosen as attention equipment, and still repeat the same processing hereafter.

[0199]

In step S98, a NFC communication device moreover, all the targets that have recognized NFCID at step S15 of drawing 14 When it judges with having chosen as attention equipment at step S91, a NFC communication device among all the targets that have recognized NFCID Command ATR_REQ and response ATR_RES are exchanged. By this When the transmission rate with which each target can communicate has been recognized, it progresses to step S99. A NFC communication device The equipment (attention equipment) which communicates is chosen from the targets which exchanged command ATR_REQ and response ATR_RES at steps S94 and S95, and it progresses to step S100.

[0200]

At step S100, a NFC communication device transmits command WUP_REQ to attention equipment, and, thereby, carries out the Wake rise of the attention equipment made into the DISEREKUTO condition by transmitting command DSL_REQ at step S96. And attention equipment waits to transmit response WUP_RES to command WUP_REQ, and progresses to S101 from step S100, and a NFC communication device receives the response WUP_RES, and progresses to step S111 of drawing 19 .

[0201]

At step S111, a NFC communication device judges whether communications parameters, such as a transmission rate at the time of performing a communication link with attention equipment, are changed.

[0202]

Here, at step S95 of drawing 18 , the NFC communication device has received response ATR_RES from attention equipment, and recognizes communications parameters, such as a transmission rate with which attention equipment can communicate, based on the attribute arranged at the response ATR_RES. A NFC communication device judges with changing a communications parameter in step S111 between for example, attention equipment, that a transmission rate should be changed into a more nearly high-speed transmission rate, when it can communicate at a high-speed transmission rate rather than a current transmission rate. Moreover, when current communication environment is an environment where a noise level is high, in order to fall a transmission error that a NFC communication device can communicate

at a low-speed transmission rate rather than a current transmission rate between for example, attention equipment, in step S111, it judges with changing a communications parameter that a transmission rate should be changed into a low speed transmission rate. In addition, even if it is the case which can communicate at a different transmission rate from a current transmission rate between a NFC communication device and attention equipment, it is possible to continue a communication link with a current transmission rate.

[0203]

In step S111, when judged with not changing the communications parameter at the time of performing a communication link with attention equipment (i.e., when continuing a communication link between a NFC communication device and attention equipment with current communications parameters, such as a current transmission rate), step S112 thru/or S114 are skipped, and it progresses to step S115.

[0204]

Moreover, in step S111, when judged with changing the communications parameter at the time of performing a communication link with attention equipment, it progresses to step S112, and a NFC communication device arranges the value of the communications parameter after the modification to command PSL_REQ, and transmits it to attention equipment. And attention equipment waits to transmit response PSL_RES to command PSL_REQ, and progresses to S113 from step S112, and a NFC communication device receives the response PSL_RES, and progresses to step S114.

[0205]

A NFC communication device is changed into the value of the communications parameter which has arranged communications parameters, such as a transmission rate at the time of performing the communication link with attention equipment, to command PSL_REQ which transmitted at step S112 at step S114. A NFC communication device performs the communication link with attention equipment according to communications parameters, such as a transmission rate of the value changed at step S114, unless the exchange of command PSL_REQ and response PSL_RES is henceforth carried out again between attention equipment.

[0206]

In addition, according to the exchange (negotiation) of command PSL_REQ and response PSL_RES, it is possible to also make a change of encoding methods other than [16 (decoding section 14)] a transmission rate (for example, the encoding section of <u>drawing 4</u>), the modulation technique of the modulation section 19 and the load modulation section 20 (recovery section 13), etc.

[0207]

Then, it progresses to step S115, and when it judges whether there are any data which should be transmitted and received between attention equipment and is judged with there being nothing, a NFC communication device skips steps S116 and S117, and progresses to step S118.

[0208]

Moreover, in step S115, when judged with there being data which should be transmitted and received between attention equipment, it progresses to step S116 and a NFC communication device transmits command DEP_REQ to attention equipment. Here, at step S116, when there are data which should be transmitted to attention equipment, a NFC communication device arranges the data to command DEP_REQ, and is transmitted.

[0209]

And attention equipment waits to transmit response DEP_RES to command DEP_REQ, and progresses to S117 from step S116, and a NFC communication device receives the response DEP_RES, and progresses to step S118.

[0210]

As mentioned above, the so-called transmission and reception of live data are performed by exchanging command DEP_REQ and response DEP_RES between a NFC communication device and attention equipment.

[0211]

At step S118, a NFC communication device judges whether a communications partner is changed. In step S118, when judged with not changing a communications partner (i.e., when there are still data exchanged between attention equipment for example), the same processing is repeated by step S111 return and the following.

[0212]

Moreover, in step S118, when judged with changing a communications partner (i.e., although there are no data exchanged between for example, attention equipment, when there are data exchanged with other communications partners), it progresses to step S119 and a NFC communication device transmits command DSL_REQ or RLS_REQ to attention equipment. And attention equipment waits to transmit response DSL_RES or RLS_RES to command DSL_REQ or RLS_REQ, and progresses to S120 from step S119, and a NFC communication device receives the response DSL_RES or RLS_RES.

[0213]

Here, as mentioned above, when a NFC communication device transmits command DSL_REQ or RLS_REQ to attention equipment, the target as the attention equipment is released from the object of the communication link with the NFC communication device as an initiator. However, although the target released by command DSL_REQ will be in an initiator and the condition which can be communicated again by command WUP_UP, the target released by command RLS_REQ will not be in an initiator and the condition which can be communicated, unless the exchange of the polling request frame mentioned above and a polling response frame is performed between initiators.

[0214]

In addition, as a case where a certain target is released from the object of the communication link with an initiator, others, for example, an initiator, and a target in case command DSL_REQ or RLS_REQ is transmitted from an initiator to a target separate too much, and there is a case where it becomes impossible to perform a contiguity communication link, as mentioned above. In this case, like the target released by command RLS_REQ, between a target and an initiator, unless the exchange of a polling request frame and a polling response frame is performed, it will not be in an initiator and the condition which can be communicated.

[0215]

Here, hereafter, suitably, between a target and an initiator, if the exchange of a polling request frame and a polling response frame is not performed, release of the target an initiator and whose communication link are not attained will be called full release. Moreover, release of the target an initiator and whose communication link are attained again is called release by transmitting command WUP_UP from an initiator temporarily.

[0216]

After processing of step S120 progresses to step S121, and a NFC communication device judges whether full release of all the targets that have recognized NFCID at step S15 of drawing 14 was carried out. In step S121, when judged with full release of all the targets that have recognized NFCID not being carried out yet, to step 99 of drawing 18 , return and a NFC communication device newly choose attention equipment, and repeat the same processing hereafter out of the target by which full release is not carried out, i.e., the target released temporarily.

[0217]

Moreover, in step S121, when judged with full release of all the targets that have recognized NFCID having been carried out, processing is ended.

[0218]

In addition, in steps S116 and S117 of drawing 19 , although transmission and reception (data exchange) of data are performed between a target and an initiator by exchanging command DEP_REQ and response DEP_RES, the exchange of this command DEL_REQ and response DEP_RES is one transaction. Through steps S118, S111, S112, and S113, after processing of steps S116 and S117 can be returned to step S114, and can change a communications parameter. Therefore, communications parameters, such as a transmission rate about the communication link between a target and an initiator, can be changed for every transaction.

[0219]

Moreover, in steps S112 and S113, it is possible by exchanging command PSL_REQ and response PSL_RES between an initiator and a target to change the communicate mode of the initiator which is one of the communications parameters, and a target at step S114. Therefore, the communicate mode of a target and an initiator can be changed for every transaction. In addition, this means that the communicate mode of a target and an initiator must not be changed between one transaction.

[0220]

Next, with reference to the flow chart of drawing 20 , the communications processing of the target in the passive mode in step S38 of drawing 15 is explained.

[0221]

In steps S37 and S38 of drawing 15 , since the NFC communication device which is the target in the passive mode is considering the exchange of response DSL_RES as command DSL_REQ between the initiators in the passive mode, it is in the DISEREKUTO condition.

[0222]

Then, in step S131, a NFC communication device is considered as as [return and a DISEREKUTO condition] at step S131, when it judges whether command WUP_REQ has been transmitted from the initiator and it is judged [not having been transmitted and].

[0223]

Moreover, in step S131, when judged with command WUP_REQ having been transmitted from the initiator (i.e., when a NFC communication device receives command WUP_REQ), it progresses to step S131, and a NFC communication device transmits response WUP_RES to command WUP_REQ, carries out the Wake rise, and progresses to step S133.

[0224]

At step S133, command ATR_REQ judges whether it has been transmitted from the initiator, and when it judges [not having been transmitted and], a NFC communication

device skips step S134, and progresses to step S135.

[0225]

Moreover, in step S133, when judged with command ATR_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command ATR_REQ), it progresses to step S135, and a NFC communication device transmits response ATR_RES to command ATR_REQ, and progresses to step S135.

[0226]

At step S135, a NFC communication device judges whether command DSL_REQ has been transmitted from the initiator. In step S135, when judged with command DSL_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command DSL_REQ), it progresses to step S136, and a NFC communication device transmits response DSL_RES to command DSL_REQ, and returns to step S131. Thereby, a NFC communication device will be in a DISEREKUTO condition.

[0227]

On the other hand, when it is judged [that command DSL_REQ has not been transmitted and] from an initiator in step S135, it progresses to step S137, and a NFC communication device judges whether command PSL_REQ has been transmitted from the initiator, when it judges [not having been transmitted and], it skips steps S138 and S139, and progresses to step S140.

[0228]

Moreover, in step S137, when judged with command PSL_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command PSL_REQ), it progresses to step S138, and a NFC communication device transmits response PSL_RES to command PSL_REQ, and progresses to step S139. At step S139, according to command PSL_REQ from an initiator, a NFC communication device changes the communications parameter, and progresses to step S140.

[0229]

At step S140, when it judges [judging whether command DEP_REQ has been transmitted and not having been transmitted from an initiator, and], a NFC communication device skips step S141, and progresses to step S142.

[0230]

Moreover, in step S140, when judged with command DEP_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command DEP_REQ), it progresses to step S141, and a NFC communication device transmits response DEP_RES to command DEP_REQ, and progresses to step S142.

[0231]

At step S142, when it judges [that a NFC communication device judges whether command RSL_REQ has been transmitted, and has not been transmitted from an initiator, and], the same processing is repeated by step S133 return and the following.

[0232]

Moreover, in step S142, when judged with command RSL_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command RSL_REQ), it progresses to step S143, and a NFC communication device transmits response RSL_RES to command RSL_REQ, thereby, it ends the communication link with an initiator completely, and ends processing.

[0233]

Next, drawing 21 and drawing 22 are flow charts which show the detail of the communications processing of the initiator in the active mode in step S61 of drawing 16 .

[0234]

In addition, by the communications processing of the initiator in the passive mode explained by drawing 18 and drawing 19 , although an initiator is continuing outputting an electromagnetic wave, by the communications processing of the initiator in the active mode of drawing 21 and drawing 22 , by performing active RFCA processing, before transmitting a command, an initiator starts the output of an electromagnetic wave and performs processing (OFF processing) which suspends the output of the electromagnetic wave after termination of transmission of a command. If this point is removed, since the step step S91 of drawing 18 step S111 of S101 and drawing 19 thru/or the respectively same processing as the case in S121 are performed, by the communications processing of the initiator in the active mode of drawing 21 , the explanation will be omitted in step S151 step S171 of S161 and drawing 22 thru/or S181.

[0235]

Next, drawing 23 is a flow chart which shows the detail of the communications processing of the target in the active mode in step S79 of drawing 17 .

[0236]

In addition, although data are transmitted in the communications processing of the target in the passive mode explained by drawing 20 when a target carries out the load modulation of the electromagnetic wave which the initiator is outputting In the communications processing of the target in the active mode of drawing 23 , a target starts the output of an electromagnetic wave by performing active RFCA processing,

before transmitting a command, and performs processing (OFF processing) which suspends the output of the electromagnetic wave after termination of transmission of a command. If this point is removed, since step S131 of drawing 20 thru/or the respectively same processing as the case in S143 are performed, by the communications processing of the target in the active mode of drawing 23 , the explanation will be omitted in step S191 thru/or S203.
[0237]
Next, with reference to drawing 24 thru/or drawing 26 , the method of coping with it in a NFC communication device of an as opposed to [hide and / a terminal problem] is explained.
[0238]
drawing 24 -- three NFC communication devices 1, 2, and 3 -- relation with the magnitude of the flux density by the electromagnetic wave is shown at each location and the level of an electromagnetic wave, i.e., here.
[0239]
In drawing 24 , the NFC communication device 2 is in the location which only a certain short distance L12 left from the NFC communication device 1, and the NFC communication device 3 is in the location which only the distance L23 longer than distance L12 separated from the NFC communication device 2. And it is separated only from distance L12+L 23 of the NFC communication devices 1 and 3.
[0240]
the NFC communication device 1 thru/or 3 -- each exchanges data between communications partners by the transformer coupling of the coils as an antenna 11 shown in drawing 4 . In addition, the communications partner of a NFC communication device does not need to be a NFC communication device, and may be the conventional IC card etc. However, like the conventional IC card in the communications partner of a NFC communication device, when supply of power is required, by transformer coupling, a NFC communication device exchanges data, and also performs supply of power.
[0241]
By the way, the electromotive force generated by the transformer coupling of coils is so large that the coils are near, and tends to decline in inverse proportion to the 3rd [about] power of the distance of the coils.
[0242]
Therefore, the flux density by the electromagnetic wave which the NFC communication device 1 outputs carries out monotone reduction in inverse proportion to the 3rd [about] power of the distance from the NFC communication device 1. in addition -- although the flux density by the electromagnetic wave which the NFC communication device 1 outputs can be divided into a carrier component Mcarr1 and the signal component Msig1 as a part of data which transmits become irregular -- this carrier component Mcarr1 and a signal component Msig1 -- as shown in drawing 24 , in inverse proportion to the 3rd [about] power of the distance from the NFC communication device 1, it decreases, respectively.
[0243]
the same -- the NFC communication devices 2 and 3 -- the flux density by the electromagnetic wave which each outputs -- the NFC communication devices 2 and 3 -- respectively -- since -- it decreases in inverse proportion to the 3rd [about] power of distance. in addition -- drawing 24 -- (-- drawing 25 and drawing 26 which are mentioned later -- also setting -- the same --) -- illustration of the flux density by the electromagnetic wave which the NFC communication device 2 outputs is omitted. Moreover, only the carrier component Mcarr3 is illustrated about the flux density by the electromagnetic wave which the NFC communication device 3 outputs, and illustration of a signal component is omitted.
[0244]
The NFC communication device 1 thru/or 3 are designed so that a with an operating-limits subcarrier flux density [as a predetermined threshold / TH] of two or more (or more size) carrier component may be needed, although data are acquired in the recovery section 13 of drawing 4 .
[0245]
While making the NFC communication device 1 into a transmitting side, when a communication link shall be now performed by making the NFC communication device 2 into a receiving side among the NFC communication devices 1 and 2, for example, in drawing 24 The NFC communication device 2 which is a receiving side is in the location which only the distance L12 whose carrier component Mcarr1 of the electromagnetic wave which the NFC communication device 1 which is a transmitting side outputs corresponds with the operating-limits subcarrier flux density TH2 left, and it exists in the most distant location that can communicate with the NFC communication device 1.
[0246]
Since the carrier component Mcarr1 of the electromagnetic wave from the NFC communication device 1 which the NFC communication device 2 receives serves as smallness from the operating-limits subcarrier flux density TH2, it becomes

impossible in addition, for the NFC communication device 2 to receive the data transmitted from the NFC communication device 1, if the distance between the NFC communication devices 1 and 2 serves as size from distance L12. This can be said for the distance which can communicate among the NFC communication devices 1 and 2 to be restricted to less than [distance L12] by the operating-limits subcarrier flux density TH2.

[0247]

Moreover, although the recovery section 13 (drawing 4) acquires data, in order to make it need a with an operating-limits subcarrier flux density [as a threshold / TH] of two or more carrier component in the NFC communication device 2 For example, only when a with an operating-limits subcarrier flux density [TH] of two or more carrier component is supplied to the recovery section 13 through an antenna 11 and a receive section 12, it sets to the 1st method of operating the recovery section 13, and a detecting element 23. Only when a with an operating-limits subcarrier flux density [TH] of two or more carrier component is detected, there is the 2nd method of operating the recovery section 13. What is necessary is to set up the operating-limits subcarrier flux density TH2 as a threshold, and just to make it detect the electromagnetic wave of with an operating-limits subcarrier flux density [as the threshold / TH] of two or more level in a detecting element 23 in the threshold setting section 24 of drawing 4 , when adopting the 2nd approach.

[0248]

Although the NFC communication device 1 thru/or 3 acquire data in the recovery section 13 as mentioned above Are designed so that the carrier component of with an operating-limits subcarrier flux density [as a predetermined threshold / TH] of two or more level may be needed, and also Furthermore, when the carrier component of with a subcarrier output control decision flux density [as other thresholds / TH] of one or more (or more size) level is not detected in the detecting element 23 (drawing 4), it is designed so that initiation of the output of an electromagnetic wave may be possible.

[0249]

That is, although the NFC communication device 1 thru/or 3 perform RFCA processing which starts the output of an electromagnetic wave when an electromagnetic wave is not detected around as drawing 9 and drawing 10 explained, in this RFCA processing, the case where an electromagnetic wave is not detected means the case where the carrier component of with a subcarrier output control decision flux density [TH] of one or more level is not detected.

[0250]

In drawing 24 , the NFC communication device 1 is in the location from which only distance L12+L 23 (both NFC communication devices 1 and 3 presuppose that it is the minimum distance with the NFC communication devices 1 and 3 which can output an electromagnetic wave to coincidence) from which the carrier component Mcarr3 of the electromagnetic wave which the NFC communication device 3 which is not a communications partner outputs becomes less than one subcarrier output control decision flux density TH in the NFC communication device 1 was separated. In this case, the output of the electromagnetic wave by the NFC communication device 1 is not barred by the output of the electromagnetic wave by the NFC communication device 3.

[0251]

In addition, it declines that it is separated only from distance L12+L 23 from which the carrier component Mcarr3 of the electromagnetic wave which the NFC communication device 3 outputs becomes less than one subcarrier output control decision flux density TH in the NFC communication device 1 of the NFC communication devices 1 and 3 so that the carrier component Mcarr1 of the electromagnetic wave which the NFC communication device 1 outputs may also become less than one subcarrier output control decision flux density TH in the NFC communication device 3. Therefore, the output of the electromagnetic wave by the NFC communication device 3 is not barred by the output of the electromagnetic wave by the NFC communication device 1, either. In addition, the level of the electromagnetic wave which a communication device 1 thru/or 3 output presupposes that it is the same here.

[0252]

As mentioned above, in drawing 24 , the output of an electromagnetic wave is possible also for the NFC communication device 1 which communicates with the NFC communication device 2, and the NFC communication device 3 which is not going to communicate with the NFC communication device 2. And since the NFC communication device 2 is in a location nearer than the NFC communication device 1 to the NFC communication device 3 and it is in a location nearer than the NFC communication device 3 also to the NFC communication device 1, the electromagnetic wave from the NFC communication device 3 will be received on level higher than the NFC communication device 1, and the electromagnetic wave from the NFC communication device 1 will also be received on level higher than the NFC communication device 3.

[0253]
Since it communicates among the NFC communication devices 1 and 2 now, the electromagnetic wave from the NFC communication device 1 which the NFC communication device 2 receives When influenced of the electromagnetic wave from the NFC communication device 3 which the NFC communication device 2 similarly receives The NFC communication device 2 cannot receive normally the data from the NFC communication device 1 which is a communications partner, but the communication link between the NFC communication devices 1 and 2 will be barred by the electromagnetic wave from the NFC communication device 3.
[0254]
Then, operating-limits subcarrier flux density TH2 is made into size from the subcarrier output control decision flux density TH1, and, thereby, is made into the value of extent by which the signal component Msig1 in the electromagnetic wave from the NFC communication device 1 which the NFC communication device 2 receives is not influenced from the carrier component Mcarr3 in the electromagnetic wave from the NFC communication device 3 which the NFC communication device 2 receives.
[0255]
As mentioned above, when distance with the NFC communication devices 1 and 3 is distance L12+L23 which the carrier component Mcarr3 in the electromagnetic wave outputted from the NFC communication device 3 decreases in the NFC communication device 1 to less than one subcarrier output control decision flux density TH Make into the operating-limits subcarrier flux density TH2 the minimum level of the carrier component from which the signal component which the carrier component Mcarr3 by the NFC communication device 3 in the NFC communication device 2 does not influence is obtained, and it is set to the NFC communication device 2. By needing the with an operating-limits subcarrier flux density [TH] of two or more carrier component Mcarr1 as an electromagnetic wave outputted from the NFC communication device 1 although the data from the NFC communication device 1 are acquired preventing that normal reception of the data as a signal component Msig1 transmitted from the NFC communication device 1 in the NFC communication device 2 when the NFC communication device 3 which is not a communications partner outputs an electromagnetic wave is barred -- that is, it can hide and a terminal problem can be solved.
[0256]
That is, in drawing 24 , the NFC communication device 3 which is present in the location where the carrier component Mcarr1 in the electromagnetic wave from the NFC communication device 1 becomes less than one subcarrier output control decision flux density TH can output an electromagnetic wave irrespective of whether the NFC communication device 1 is outputting the electromagnetic wave. That is, the NFC communication devices 1 and 3 can output an electromagnetic wave to coincidence.
[0257]
And in drawing 24 , the NFC communication device 2 receives the carrier component Mcarr3 smaller than the operating-limits subcarrier flux density TH2 from the NFC communication device 3 while receiving the carrier component Mcarr1 of the operating-limits subcarrier flux density TH2 from the NFC communication device 1. The NFC communication device 2 cannot carry out normal reception of the data transmitted from the NFC communication device 3, although normal reception of the data transmitted from the NFC communication device 1 can be carried out since a with an operating-limits subcarrier flux density [TH] of two or more carrier component is needed, although the data transmitted from other equipments are acquired. Furthermore, since it is separated only from distance L12+L 23 which the carrier component Mcarr3 in the electromagnetic wave outputted from the NFC communication device 3 decreases in the NFC communication device 1 to less than one subcarrier output control decision flux density TH of the NFC communication devices 1 and 3 Depending on how to decide the operating-limits subcarrier flux density TH2 mentioned above, the carrier component Mcarr3 which the NFC communication device 2 receives from the NFC communication device 3 does not influence the signal component Msig1 which the NFC communication device 2 receives from the NFC communication device 1. Therefore, the NFC communication device 2 can carry out normal reception of the data transmitted from the NFC communication device 1 irrespective of whether the NFC communication device 3 is outputting the electromagnetic wave.
[0258]
Next, drawing 25 shows the level of an electromagnetic wave in case NFC communication device 2' other than the NFC communication device 1 shown in drawing 24 thru/or 3 exists.
[0259]
To the NFC communication device 1, NFC communication device 2' is a location nearer than the NFC communication device 2, and is located in a distant location rather than the NFC communication device 2 to the NFC communication device 3.

[0260]
In addition, the level (flux density) in NFC communication device #j of carrier component Mcarr#i in the electromagnetic wave which outputs NFC communication device #i, and signal-component Msig#i is hereafter indicated suitably to be carrier component Mcarr#i (#j) and signal-component Msig#i (#j), respectively.
[0261]
In drawing 25 , since NFC communication device 2' is located in a near location rather than the NFC communication device 2 to the NFC communication device 1 supposing the NFC communication device 1 and 2' communicate, the carrier component Mcarr1 (2') which NFC communication device 2' receives from the NFC communication device 1 has the NFC communication device 2 larger than the carrier component Mcarr1 (2) received from the NFC communication device 1. Therefore, the signal component Msig1 (2') which NFC communication device 2' receives from the NFC communication device 1 also has the NFC communication device 2 larger than the signal component Msig1 (2) which receives from the NFC communication device 1.
[0262]
Moreover, since NFC communication device 2' is located in a distant location rather than the NFC communication device 2 to the NFC communication device 3, the carrier component Mcarr3 (2') which NFC communication device 2' receives from the NFC communication device 3 has the NFC communication device 2 smaller than the carrier component Mcarr3 (2) received from the NFC communication device 3.
[0263]
When the NFC communication devices 1 and 2 communicate, the ratio of the signal component Msig1 (2) which the NFC communication device 2 receives from the NFC communication device 1, and the carrier component Mcarr3 (2) which the NFC communication device 2 receives from the NFC communication device 3 turns into SN (Signal Noise) ratio. the same -- NFC -- a communication device -- one -- two -- ' -- a communication link -- carrying out -- a case -- **** -- NFC -- a communication device -- two -- ' -- NFC -- a communication device -- one -- from -- receiving -- a signal component -- Msig -- one (2') -- NFC -- a communication device -- two -- ' -- NFC -- a communication device -- three -- from -- receiving -- a carrier component -- Mcarr -- three (2') -- a ratio -- an SN ratio -- becoming .
[0264]
And as mentioned above, it is smallness from the carrier component Mcarr3 (2) to which the NFC communication device 2 receives the carrier component Mcarr3 (2') which is size and NFC communication device 2' receives from the NFC communication device 3 from the NFC communication device 3 from the signal component Msig1 (2) to which the NFC communication device 2 receives the signal component Msig1 (2') which NFC communication device 2' receives from the NFC communication device 1 from the NFC communication device 1.
[0265]
Therefore, the SN ratio (**Msig1(2')/Mcarr3 (2')) of NFC communication device 2' becomes better than the SN ratio (**Msig1(2) / Mcarr3 (2)) of the NFC communication device 2.
[0266]
As mentioned above, also when NFC communication device 2' which is the communications partner of a NFC communication device is a location nearer than the NFC communication device 2 and is located in a distant location rather than the NFC communication device 2 to the NFC communication device 3 to the NFC communication device 1, it can hide and a terminal problem can be solved.
[0267]
In addition, when NFC communication device 2' is located in a distant location rather than the NFC communication device 2 to the NFC communication device 1, the carrier component Mcarr1 (2') from the NFC communication device 1 received in NFC communication device 2' does not become two or more operating-limits subcarrier flux density TH. Therefore, in this case, primarily, since a communication device 1 and 2' cannot communicate, it hides and a terminal problem is not generated.
[0268]
Next, drawing 26 shows the level of an electromagnetic wave in case NFC communication device 3' other than the NFC communication device 1 shown in drawing 24 thru/or 3 exists.
[0269]
NFC communication device 3' -- the NFC communication devices 1 and 2 -- it is alike, respectively, and it receives and is located in a distant location rather than the NFC communication device 3.
[0270]
therefore -- NFC -- a communication device -- one -- outputting -- an electromagnetic wave -- a carrier component -- Mcarr -- one -- NFC -- a communication device -- three -- ' -- a location -- setting -- a subcarrier -- an output -- control -- decision -- flux density -- TH -- one -- being small -- level -- decreasing -- NFC -- a communication device -- three -- ' -- outputting -- an electromagnetic wave -- a carrier component -- Mcarr -- three -- ' -- the location

of the NFC communication device 1 — setting — level smaller than the subcarrier output control decision flux density TH1 — decreasing . For this reason, the NFC communication device 1 and 3' can output an electromagnetic wave to coincidence like the case in the NFC communication devices 1 and 3 in drawing 24 .

[0271]

And since NFC communication device 3' is located in a distant location rather than the NFC communication device 3 to the NFC communication device 2, carrier component Mcarr3' (2) which the NFC communication device 2 receives from NFC communication device 3' has the NFC communication device 2 smaller than the carrier component Mcarr3 (2) received from the NFC communication device 3.

[0272]

When the NFC communication device 2 communicates with the NFC communication device 1, the electromagnetic wave which the NFC communication device 3 and 3' output is equal to a noise, and as mentioned above, the NFC communication device 2 is smaller [carrier component Mcarr3' (2) which the NFC communication device 2 receives from NFC communication device 3'] than the carrier component Mcarr3 (2) received from the NFC communication device 3.

[0273]

Therefore, about an SN ratio in case the NFC communication device 2 communicates with the NFC communication device 1, the direction of an SN ratio (**Msig1 (2) /Mcarr3' (2)) when NFC communication device 3' is outputting the electric wave becomes good as compared with an SN ratio (**Msig1(2) / Mcarr3 (2)) when the NFC communication device 3 is outputting the electric wave.

[0274]

as mentioned above, the NFC communication devices 1 and 2 with which NFC communication device 3' which is not a communications partner communicates — even if it is alike, respectively, and receives and is located in a distant location rather than the NFC communication device 3, it can hide and a terminal problem can be solved.

[0275]

In addition, when NFC communication device 3' is located in a near location rather than the NFC communication device 3 to the NFC communication device 1, the carrier component Mcarr1 of the electric-wave magnetic wave which the NFC communication device 1 outputs is with a subcarrier output control decision flux density [TH] of one or more level, and reaches NFC communication device 3'. Therefore, in this case, NFC communication device 3' is that (it does not carry out) which cannot output an electromagnetic wave, it hides and a terminal problem is not generated.

[0276]

Although the NFC communication device 1 outputted the electromagnetic wave in the above-mentioned case, data were transmitted to the NFC communication device 2 here and the NFC communication device 2 explained the case where the data was received The NFC communication device 2 transmits data to the NFC communication device 1, and even if the NFC communication device 1 is the case where the data is received preventing that reception of the data based on the NFC communication device 1 is barred when the NFC communication device 3 outputs an electromagnetic wave — that is, it can hide and a terminal problem can be solved.

[0277]

That is, when the NFC communication device 2 is the initiator in the passive mode, or when communicating in the active mode, the NFC communication device 2 outputs an electromagnetic wave in person, and transmits data. Since the carrier component of the electromagnetic wave is adult level and reaches the NFC communication device 3 from the subcarrier output control decision flux density TH1 when the NFC communication device 2 located in a near location rather than the NFC communication device 1 outputs an electromagnetic wave to the NFC communication device 3, the NFC communication device 3 cannot output an electromagnetic wave, hides, and does not generate a terminal problem.

[0278]

On the other hand, when the NFC communication device 2 is the target in the passive mode, the NFC communication device 2 transmits data to the NFC communication device 1 by carrying out the load modulation of the electromagnetic wave which the NFC communication device 1 which is the initiator in the passive mode outputs. Therefore, when the signal component which reaches the NFC communication device 1 by the load modulation is influenced of the electromagnetic wave which the NFC communication device 3 outputs, in the NFC communication device 1, the data transmitted from the NFC communication device 2 can be received.

[0279]

Therefore, if it says conversely, when separated only from distance L12+L 23 from which the carrier component Mcarr3 of the electromagnetic wave which the NFC communication device 3 (1) outputs becomes less than one subcarrier output control decision flux density TH of the NFC communication devices 1 and 3 In the NFC communication device 1, if the signal component by the load modulation of the NFC

communication device 2 which is not influenced of the carrier component Mcarr3 of the NFC communication device 3 is receivable, the data transmitted from the NFC communication device 2 can be received.

[0280]

As mentioned above, so that the SN ratio to the electromagnetic wave which the NFC communication device 3 of the signal component which reaches the NFC communication device 1 by the load modulation by the NFC communication device 2 outputs may serve as sufficient magnitude The load percent modulation of the load modulation in the NFC communication device 2 is set up. The NFC communication devices 1 and 3 When separated only from distance L12+L 23 from which the carrier component Mcarr3 of the electromagnetic wave which the NFC communication device 3 (1) outputs becomes less than one subcarrier output control decision flux density TH The time of the minimum SN ratio to which the NFC communication device 1 can carry out normal reception of the data from the NFC communication device 2, without being influenced by the electromagnetic wave from the NFC communication device 3 being securable, By making into the operating-limits subcarrier flux density TH2 the carrier component Mcarr1 of the electromagnetic wave which the NFC communication device 1 outputs in the NFC communication device 2, it can hide and a terminal problem can be solved.

[0281]

Next, by drawing 24 thru/or drawing 26 , as it explained, it hides, and a terminal problem is solved, and control processing (transmit/receive control processing) of the transmission and reception of the data in the case of transmitting and receiving data is explained. In addition, this transmit/receive control processing is performed by the control section 21 of drawing 4 .

[0282]

First, with reference to the flow chart of drawing 27 , transmit/receive control processing of the initiator in the passive mode when a NFC communication device becomes the initiator in the passive mode is explained.

[0283]

First, in step S211, a control section 21 (drawing 4) returns to step S211, when it judges with having judged and detected whether the electromagnetic wave of with a subcarrier output control decision flux density [TH] of one or more level was detected in the detecting element 23. That is, since an electromagnetic wave cannot be outputted when the electromagnetic wave of with a subcarrier output control decision flux density [TH] of one or more level is detected, the judgment of whether the electromagnetic wave of with a subcarrier output control decision flux density [TH] of one or more level was detected is continued. In addition, when processing of step S211 is performed, the threshold setting section 24 sets the threshold supplied to a detecting element 23 as the subcarrier output control decision flux density TH1, and supplies it to a detecting element 23.

[0284]

And in step S211, when judged with the electromagnetic wave of with a subcarrier output control decision flux density [TH] of one or more level not being detected, it progresses to step S212, and a control section 21 permits the output of the electromagnetic wave by the electromagnetic wave output section 18, and transmission of the data based on modulating the electromagnetic wave, and progresses to step S213. Thereby, the electromagnetic wave output section 18 starts the output of an electromagnetic wave, and the modulation section 19 will be in the condition which can modulate an electromagnetic wave. In addition, as mentioned above, the initiator in the passive mode continues outputting an electromagnetic wave until the communication link with a target is completed.

[0285]

At step S213, a control section 21 permits the reception and the recovery of data which are transmitted when the target in the passive mode carries out the load modulation of the electromagnetic wave which self is outputting to the recovery section 13, and progresses to step S214. Thereby, in the recovery section 13, the recovery of the data transmitted when the target in the passive mode carries out the load modulation of the electromagnetic wave which the initiator in the passive mode is outputting is started.

[0286]

Then, it progresses to step S214, and when it judges with a control section 21 judging whether the communication link with the target in the passive mode was completed completely, and not being completed, it returns to step S214. Moreover, in step S214, when judged with the communication link with the target in the passive mode having been completed completely, a control section 21 forbids the output of the electromagnetic wave by the electromagnetic wave output section 18, and reception of the data based on restoring to the electromagnetic wave which transmitted and modulated [load] the data based on modulating the electromagnetic wave, and ends processing.

[0287]

Next, with reference to the flow chart of drawing 28 , transmit/receive control

processing of the target in the passive mode when a NFC communication device becomes the target in the passive mode is explained.

[0288]

First, in step S221, a control section 21 (drawing 4) judges whether in the detecting element 23, the electromagnetic wave of with an operating-limits subcarrier flux density [TH] of two or more level was detected. In addition, when processing of step S221 is performed, the threshold setting section 24 sets the threshold supplied to a detecting element 23 as the operating-limits subcarrier flux density TH2, and supplies it to a detecting element 23.

[0289]

In step S221, when judged with the electromagnetic wave of with an operating-limits subcarrier flux density [TH] of two or more level having been detected, it progresses to step S222, and a control section 21 permits reception of the data based on restoring to the electromagnetic wave transmitted from the initiator in the passive mode, and transmission of the data based on carrying out the load modulation of the electromagnetic wave, and progresses to step S224. Thereby, the load modulation section 20 will be in the condition which can perform the load modulation of an electromagnetic wave, and the recovery section 13 will start the recovery of the electromagnetic wave which the initiator in the passive mode is outputting.

[0290]

On the other hand, when judged with the electromagnetic wave of with an operating-limits subcarrier flux density [TH] of two or more level not being detected in step S221, it progresses to step S223, and a control section 21 forbids reception of the data based on restoring to an electromagnetic wave by the recovery section 13, and transmission of the data based on carrying out the load modulation of the electromagnetic wave by the load modulation section 20, and progresses to step S224.

[0291]

At step S224, when it judges with a control section 21 judging whether the communication link with the initiator in the passive mode was completed completely, and not being completed, it returns to step S221. Moreover, in step S221, when judged with the communication link with the initiator in the passive mode having been completed completely, a control section 21 forbids reception of the data based on restoring to an electromagnetic wave by the recovery section 13, and transmission of the data based on carrying out the load modulation of the electromagnetic wave by the load modulation section 20, and ends processing.

[0292]

Next, with reference to the flow chart of drawing 29 , transmit/receive control processing of the initiator in the active mode when a NFC communication device becomes the initiator in the active mode is explained.

[0293]

First, in step S231, a control section 21 (drawing 4) judges whether in the detecting element 23, the electromagnetic wave of with a subcarrier output control decision flux density [TH] of one or more level was detected. In addition, when processing of step S231 is performed, the threshold setting section 24 sets the threshold supplied to a detecting element 23 as the subcarrier output control decision flux density TH1, and supplies it to a detecting element 23.

[0294]

In step S231, when judged with the electromagnetic wave of with a subcarrier output control decision flux density [TH] of one or more level having been detected, it progresses to step S232, and a control section 21 forbids the output of the electromagnetic wave by the electromagnetic wave output section 18, and transmission of the data based on modulating an electromagnetic wave by the modulation section 19, and progresses to step S234. That is, since an electromagnetic wave cannot be outputted when the electromagnetic wave of with a subcarrier output control decision flux density [TH] of one or more level is detected, the output of an electromagnetic wave, as a result transmission of the data based on the electromagnetic wave are forbidden.

[0295]

Moreover, in step S231, when judged with the electromagnetic wave of with a subcarrier output control decision flux density [TH] of one or more level not being detected, it progresses to step S233, and a control section 21 permits the output of the electromagnetic wave by the electromagnetic wave output section 18, and transmission of the data based on modulating the electromagnetic wave, and progresses to step S234. the electromagnetic wave output section 18 starts the output of an electromagnetic wave by this -- moreover, it will be in a respectively possible condition that the modulation section 19 modulates an electromagnetic wave.

[0296]

At step S234, a control section 21 judges whether in the detecting element 23, the electromagnetic wave of with an operating-limits subcarrier flux density [TH] of two or more level was detected. In addition, when processing of step S234 is performed, the threshold setting section 24 sets the threshold supplied to a detecting element 23 as the operating-limits subcarrier flux density TH2, and supplies it to a detecting

element 23.

[0297]

In step S234, when judged with the electromagnetic wave of with an operating-limits subcarrier flux density [TH] of two or more level having been detected, it progresses to step S235, and a control section 21 permits reception of the data based on restoring to the electromagnetic wave transmitted from the target in the active mode, and progresses to step S237. Thereby, the recovery section 13 will be in the condition which can restore to the electromagnetic wave which the target in the active mode outputs.

[0298]

On the other hand, when judged with the electromagnetic wave of with an operating-limits subcarrier flux density [TH] of two or more level not being detected in step S234, it progresses to step S236, and a control section 21 forbids reception of the data based on restoring to an electromagnetic wave by the recovery section 13, and progresses to step S237.

[0299]

At step S237, when it judges with a control section 21 judging whether the communication link with the target in the active mode was completed completely, and not being completed, it returns to step S231. Moreover, in step S237, when judged with the communication link with the target in the active mode having been completed completely, a control section 21 forbids the output of the electromagnetic wave by the electromagnetic wave output section 18, reception of the data based on restoring to an electromagnetic wave by the recovery section 13, and transmission of the data based on modulating an electromagnetic wave by the modulation section 19, and ends processing.

[0300]

Next, drawing 30 shows the flow chart explaining transmit/receive control processing of the target in the active mode when a NFC communication device becomes the target in the active mode. In addition, in transmit/receive control processing of the target in the active mode, in step S241 thru/or S247, since step S231 of drawing 29 thru/or the respectively same processing as the case in S237 are performed, the explanation is omitted.

[0301]

As mentioned above, in a NFC communication device, since the electromagnetic wave of with an adult operating-limits subcarrier flux density [TH] of two or more level is needed from the subcarrier output control decision flux density TH1 although the output of an electromagnetic wave is started and normal reception of the data is carried out when the electromagnetic wave of with a subcarrier output control decision flux density [TH] of one or more level is not detected, it can perform hiding and solving a terminal problem easily only by detection of an electromagnetic wave.

[0302]

That is, in a NFC communication device, since control logic, memory, etc. which are needed when [which is depended on the commands RTS and CTS mentioned above] hiding and adopting the solution technique of a terminal problem are not needed, by low cost, it can hide and a terminal problem can be solved.

[0303]

Furthermore, in a NFC communication device, since it is not necessary to exchange Commands RTS and CTS, it can hide and a terminal problem can be solved quickly.

[0304]

Moreover, in a NFC communication device, although normal reception of the data is carried out, since the electromagnetic wave of with an adult operating-limits subcarrier flux density [TH] of two or more level is needed from the subcarrier output control decision flux density TH1, the distance for transmitting and receiving data between communications partners can be restrained within a certain fixed distance. Furthermore, the radio channel by transformer coupling is established by using an antenna 11 as a coil, and since it was made for attenuation of an electromagnetic wave to also serve as size when the distance of NFC communication devices served as size, constraint of distance with the communications partner for carrying out normal reception of the data can be made firm (what must be protected).

[0305]

Moreover, in the above-mentioned case, when the electromagnetic wave of with an operating-limits subcarrier flux density [TH] of two or more level was not detected in the detecting element 23, were made not to receive data by forbidding the recovery of the data in the recovery section 13, but in addition, when supply of the power from a communications partner constitutes a NFC communication device like the conventional IC card so that it may be required If the electromagnetic wave of with an operating-limits subcarrier flux density [TH] of two or more level is not received, the electromagnetic wave of with an operating-limits subcarrier flux density [TH] of two or more level can be needed for reception of data by power required for actuation of equipment being made not to be obtained.

[0306]

Furthermore, in an above-mentioned case, in the threshold setting section 24, set up

the subcarrier output control decision flux density TH1 or the operating-limits subcarrier flux density TH2 as a threshold, and it sets to a detecting element 23. Although it was made to detect the electromagnetic wave of the level of the subcarrier output control decision flux density TH1 and 2 or more each of operating-limits subcarrier flux density TH As drawing 4 explained, it is able to form detecting elements 23 and 25 and to make it for the electromagnetic wave of the level of the subcarrier output control decision flux density TH1 and 2 or more each of operating-limits subcarrier flux density TH to make each detect. However, the direction which is only a detecting element 23 and the electromagnetic wave of with the subcarrier output control decision flux density TH1 and an operating-limits subcarrier flux density [TH] of two or more level detects is advantageous in cost rather than it prepares two of detecting elements 23 and 25.

[0307]

In addition, it is not necessary to necessarily process the processing step explaining the processing which a NFC communication device performs to time series in accordance with the sequence indicated as a flow chart, and it is a juxtaposition thing also including the processing (for example, parallel processing or processing by the object) performed according to an individual in this specification.

[0308]

Moreover, although the gestalt of this operation explained the case where this invention was applied to the NFC communication device which can transmit and receive the data in two or more transmission rates, in addition to this, this invention is applicable to the communication device which can only transmit and receive the data in a certain single transmission rate.

[0309]

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the example of a configuration of the gestalt of 1 operation of the communication system which applied this invention.

[Drawing 2] It is drawing explaining the passive mode.

[Drawing 3] It is drawing explaining the active mode.

[Drawing 4] It is the block diagram showing the example of a configuration of the NFC communication device 1.

[Drawing 5] It is the block diagram showing the example of a configuration of the recovery section 13.

[Drawing 6] It is the block diagram showing the example of a configuration of the modulation section 19.

[Drawing 7] It is the block diagram showing other examples of a configuration of the recovery section 13.

[Drawing 8] It is the block diagram showing the example of a configuration of further others of the recovery section 13.

[Drawing 9] It is a timing chart explaining initial RFCA processing.

[Drawing 10] It is a timing chart explaining active RFCA processing.

[Drawing 11] It is drawing explaining SDD processing.

[Drawing 12] It is drawing showing the list of a command and responses.

[Drawing 13] It is a flow chart explaining processing of a NFC communication device.

[Drawing 14] It is the flow chart which shows processing of the initiator in the passive mode.

[Drawing 15] It is the flow chart which shows processing of the target in the passive mode.

[Drawing 16] It is the flow chart which shows processing of the initiator in the active mode.

[Drawing 17] It is the flow chart which shows processing of the target in the active mode.

[Drawing 18] It is the flow chart which shows the communications processing of the initiator in the passive mode.

[Drawing 19] It is the flow chart which shows the communications processing of the initiator in the passive mode.
[Drawing 20] It is the flow chart which shows the communications processing of the target in the passive mode.
[Drawing 21] It is the flow chart which shows the communications processing of the initiator in the active mode.
[Drawing 22] It is the flow chart which shows the communications processing of the initiator in the active mode.
[Drawing 23] It is the flow chart which shows the communications processing of the target in the active mode.
[Drawing 24] It is drawing which hides and explains the management to a terminal problem.
[Drawing 25] It is drawing which hides and explains the management to a terminal problem.
[Drawing 26] It is drawing which hides and explains the management to a terminal problem.
[Drawing 27] It is the flow chart which shows transmit/receive control processing of the initiator in the passive mode.
[Drawing 28] It is the flow chart which shows transmit/receive control processing of the target in the passive mode.
[Drawing 29] It is the flow chart which shows transmit/receive control processing of the initiator in the active mode.
[Drawing 30] It is the flow chart which shows transmit/receive control processing of the target in the active mode.
[Description of Notations]
1 thru/or 3 NFC communication device 11 An antenna, 12 Receive section 13 The recovery section, 14 Decoding section 15 The data-processing section, 16 Encoding section 17 The selection section, 18 Electromagnetic wave output section 19 The modulation section, 20 Load modulation section 21 A control section, 22 Power supply section 23 A detecting element, 24 Threshold setting section 25 detecting elements 31 Selection section 321 thru/or 32Ns Recovery section 33 41 Selection section 421 thru/or 42Ns Modulation section 43 Selection section 51 Adjustable rate recovery section 52 Rate detecting element

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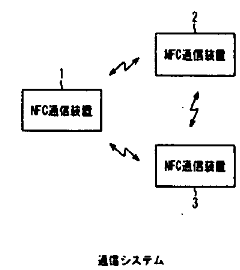
[Translation done.]

DRAWINGS

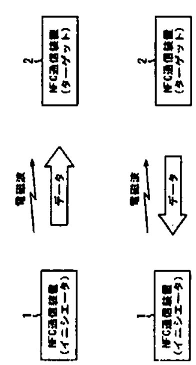
[Drawing 1]

図1



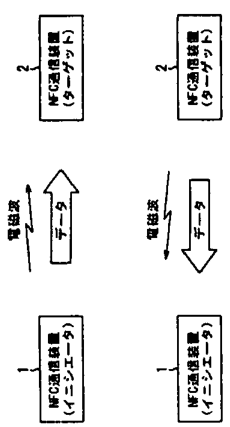
[Drawing 2]

図2



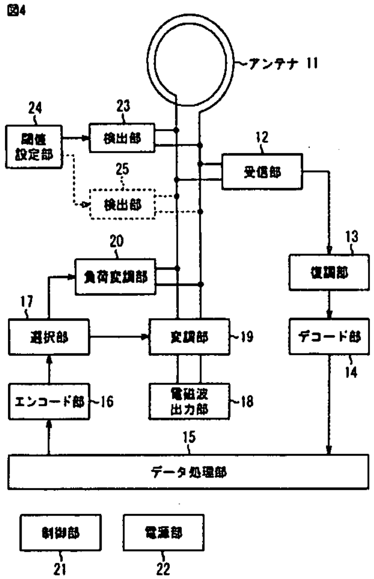
[Drawing 3]

図3



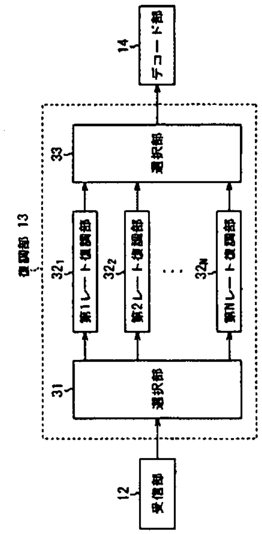
[Drawing 4]

図4



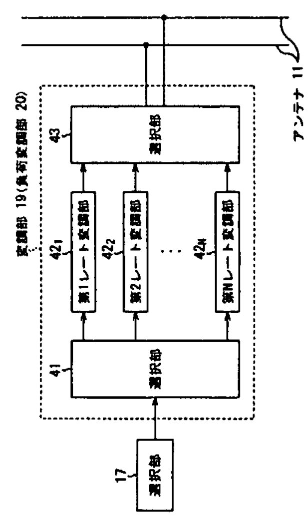
[Drawing 5]

図5



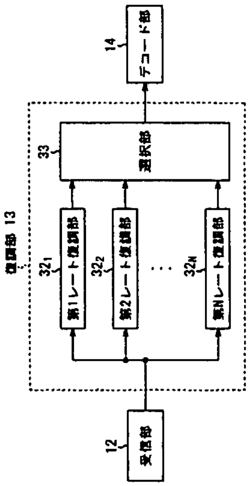
[Drawing 6]

図6



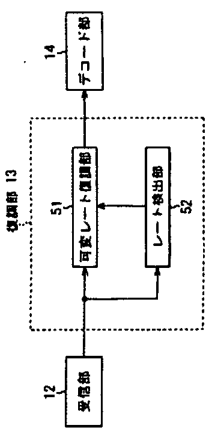
[Drawing 7]

図7



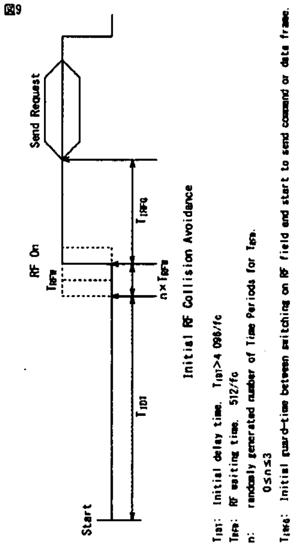
[Drawing 8]

図8



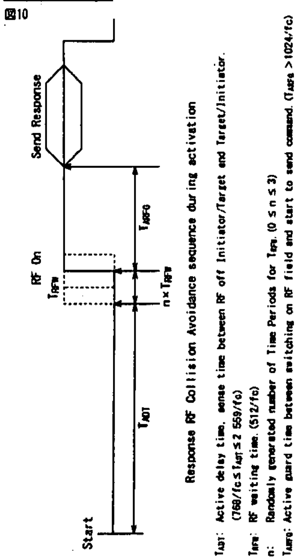
[Drawing 9]

図9



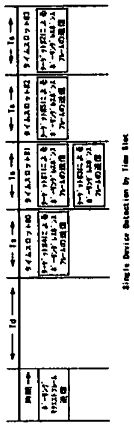
[Drawing 10]

図10



[Drawing 11]

図11



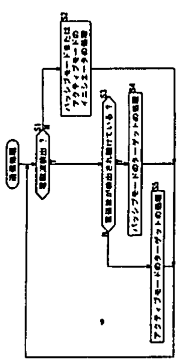
[Drawing 12]

図12

コマンド/レスポンス
ATR_REQ
ATR_RES
WUP_REQ
WUP_RES
PSL_REQ
PSL_RES
DEP_REQ
DEP_RES
DSL_REQ
DSL_RES
RLS_REQ
RLS_RES

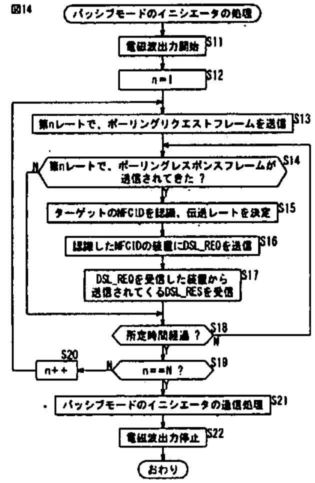
[Drawing 13]

図13



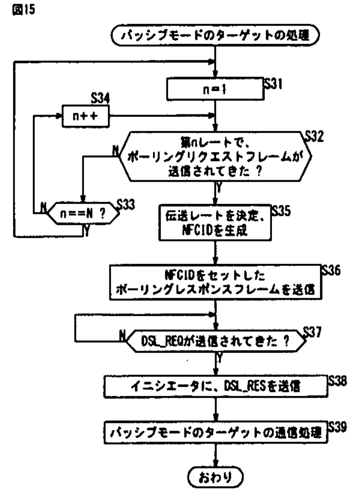
[Drawing 14]

図14



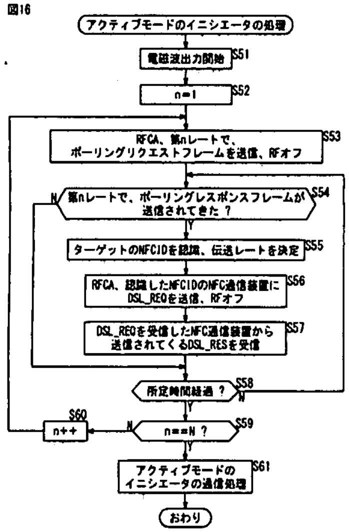
[Drawing 15]

図15



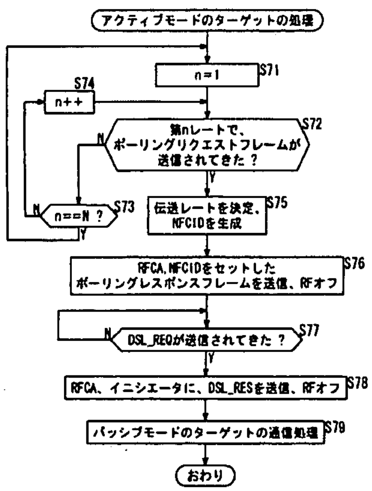
[Drawing 16]

図16



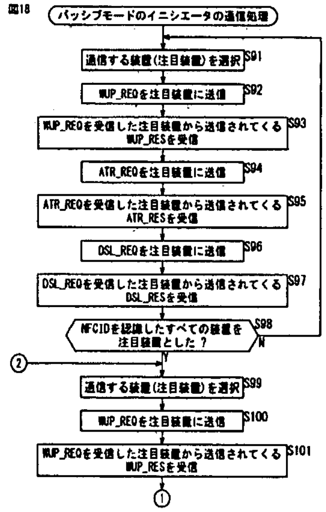
[Drawing 17]

図17



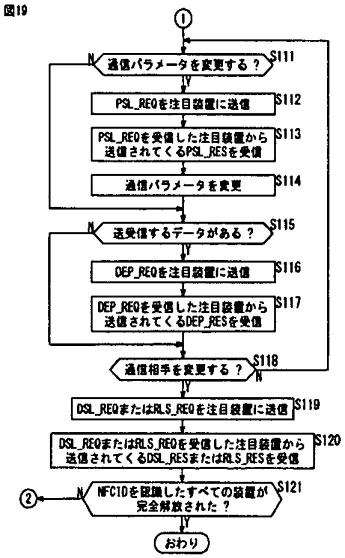
[Drawing 18]

図18



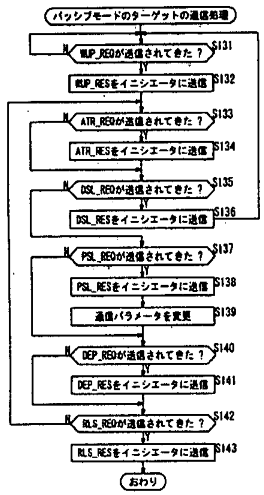
[Drawing 19]

図19



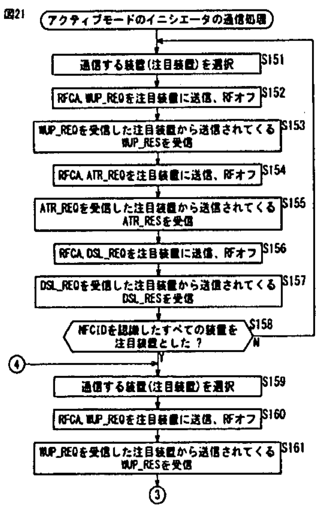
[Drawing 20]

図20



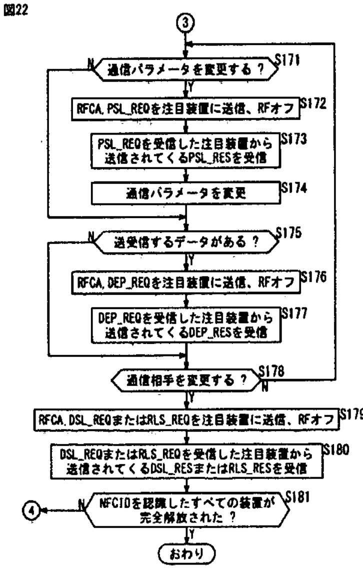
[Drawing 21]

図21



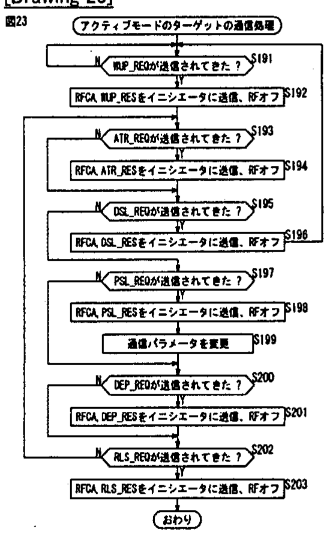
[Drawing 22]

図22



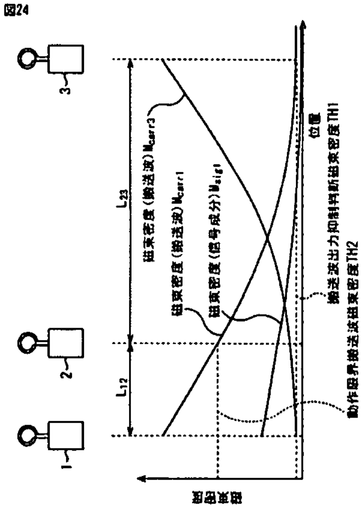
[Drawing 23]

図23



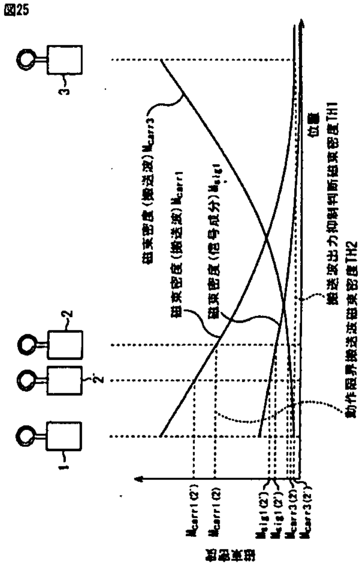
[Drawing 24]

図24



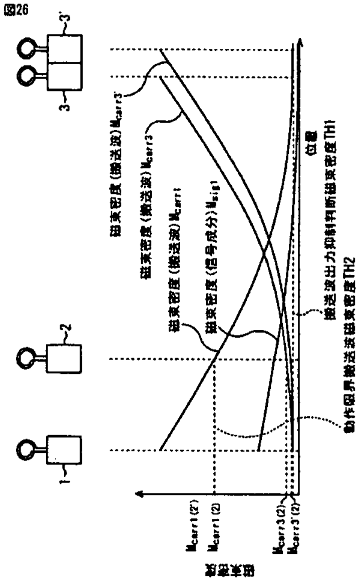
[Drawing 25]

図25



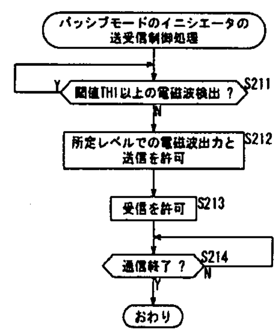
[Drawing 26]

図26



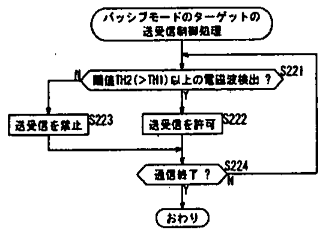
[Drawing 27]

図27



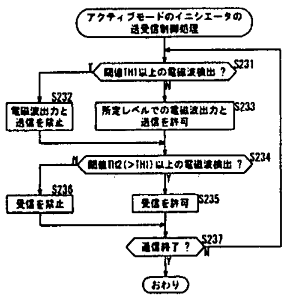
[Drawing 28]

図28



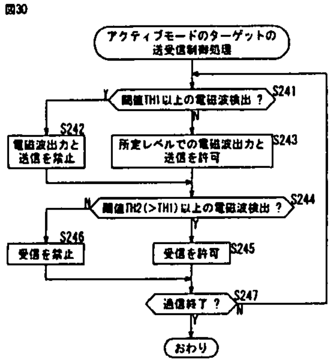
[Drawing 29]

図29



[Drawing 30]

図30



[Translation done.]

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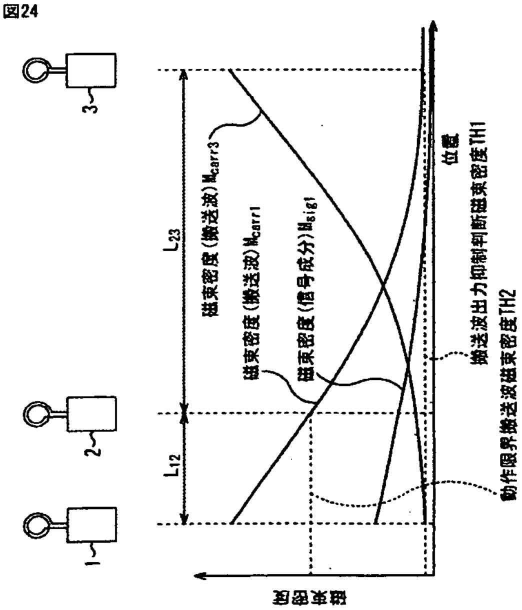
最終頁に続く

(54)【発明の名称】通信システム、並びに通信装置および通信方法

(57)【要約】
【課題】隠れ端末問題を、容易に解消する。
【解決手段】通信装置１と３は、搬送波出力抑制判断磁束密度TH1以上のレベルの電磁波が検出されているかどうかを判定し、搬送波出力抑制判断磁束密度TH1以上のレベルの電磁波が検出されていない場合に、電磁波の出力を開始する。一方、通信装置２は、電磁波を介してデータを取得するのに、搬送波出力抑制判断磁束密度TH1より大の動作限界搬送波磁束密度TH2以上のレベルの電磁波を必要とする。本発明は、例えば、IC(Integrated Curcuit)カードシステムなどに適用することができる。
【選択図】　　図２４

図24



【特許請求の範囲】

【請求項１】

第１と第２の通信装置からなる通信システムにおいて、
前記第１および第２の通信装置は、
電磁波を変調することにより、複数の伝送レートのうちのいずれかの伝送レートでデータを送信する変調手段と、
電磁波を復調することにより、複数の伝送レートのうちのいずれかの伝送レートで、他の装置から送信されてくるデータを取得する復調手段と、
電磁波を検出する検出手段と
を備え、
前記第１の通信装置は、前記検出手段において第１の閾値以上のレベルの電磁波が検出されていない場合に、電磁波の出力を開始し、
前記第２の通信装置は、前記復調手段においてデータを取得するのに、前記第１の閾値より大の第２の閾値以上のレベルの電磁波を必要とする
ことを特徴とする通信システム。

【請求項２】

前記検出手段は、前記第１の閾値以上のレベルの電磁波と、前記第２の閾値以上のレベルの電磁波とを検出し、
前記第２の通信装置は、前記検出手段において第２の閾値以上のレベルの電磁波が検出されている場合に、前記復調手段においてデータを取得する
ことを特徴とする請求項１に記載の通信システム。

【請求項３】

前記第１および第２の通信装置は、前記検出手段に検出させる電磁波のレベルの閾値を設定する閾値設定手段をさらに備え、
前記検出手段は、前記閾値設定手段によって設定される閾値に応じて、前記１の閾値以上のレベルの電磁波と、前記第２の閾値以上のレベルの電磁波とを検出する
ことを特徴とする請求項２に記載の通信システム。

【請求項４】

前記第１と第２の閾値は、隠れ端末問題が生じないように設定される
ことを特徴とする請求項１に記載の通信システム。

【請求項５】

前記電磁波によるデータの送受信を、コイル状のアンテナを介して行う
ことを特徴とする請求項１に記載の通信システム。

【請求項６】

電磁波を変復調することによりデータを送受信する通信装置において、
電磁波を発生することにより、RF(Radio Frequency)フィールドを形成する電磁波発生手段と、
電磁波を変調することにより、複数の伝送レートのうちのいずれかの伝送レートでデータを送信する変調手段と、
電磁波を復調することにより、複数の伝送レートのうちのいずれかの伝送レートで、他の装置から送信されてくるデータを取得する復調手段と、
電磁波を検出する検出手段と
を備え、
前記検出手段において第１の閾値以上のレベルの電磁波が検出されていない場合に、電磁波の出力を開始し、
その電磁波が、前記第１の閾値より大の第２の閾値以上のレベルで到達する位置にある前記他の装置と通信する
ことを特徴とする通信装置。

【請求項７】

電磁波を変復調することによりデータを送受信する通信方法において、

電磁波を発生することにより、RF(Radio Frequency)フィールドを形成する電磁波発生ステップと、
電磁波を変調することにより、複数の伝送レートのうちのいずれかの伝送レートでデータを送信する変調ステップと、
電磁波を復調することにより、複数の伝送レートのうちのいずれかの伝送レートで、他の装置から送信されてくるデータを取得する復調ステップと、
電磁波を検出する検出ステップと
を備え、
前記検出ステップにおいて第１の閾値以上のレベルの電磁波が検出されていない場合に、電磁波の出力を開始し、
その電磁波が、前記第１の閾値より大の第２の閾値以上のレベルで到達する位置にある前記他の装置と通信する
ことを特徴とする通信方法。
【請求項８】
電磁波を変復調することによりデータを送受信する通信装置において、
電磁波を変調することにより、複数の伝送レートのうちのいずれかの伝送レートでデータを送信する変調手段と、
電磁波を復調することにより、複数の伝送レートのうちのいずれかの伝送レートで、他の装置から送信されてくるデータを取得する復調手段と、
を備え、
前記他の装置が、第１の閾値以上のレベルの電磁波が存在しないことを確認して、電磁波の出力を開始する場合に、前記復調手段においてデータを取得するのに、前記第１の閾値より大の第２の閾値以上のレベルの電磁波を必要とする
ことを特徴とする通信装置。
【請求項９】
電磁波を検出する検出手段をさらに備え、
前記検出手段において第２の閾値以上のレベルの電磁波が検出されている場合に、前記復調手段においてデータを取得する
ことを特徴とする請求項８に記載の通信装置。
【請求項１０】
電磁波を発生することにより、RF(Radio Frequency)フィールドを形成する電磁波発生手段をさらに備え、
前記変調手段は、前記電磁波発生手段が出力する電磁波を変調することにより、データを送信し、
前記検出手段は、前記第１の閾値以上のレベルの電磁波と、前記第２の閾値以上のレベルの電磁波とを検出し、
前記検出手段において第１の閾値以上のレベルの電磁波が検出されていない場合に、前記電磁波発生手段による電磁波の出力を開始する
ことを特徴とする請求項９に記載の通信装置。
【請求項１１】
前記変調手段は、前記他の装置が発生する電磁波を負荷変調することにより、データを送信する
ことを特徴とする請求項８に記載の通信装置。
【請求項１２】
電磁波を変復調することによりデータを送受信する通信方法において、
電磁波を変調することにより、複数の伝送レートのうちのいずれかの伝送レートでデータを送信する変調ステップと、
電磁波を復調することにより、複数の伝送レートのうちのいずれかの伝送レートで、他の装置から送信されてくるデータを取得する復調ステップと、
を備え、

前記他の装置が、第１の閾値以上のレベルの電磁波が存在しないことを確認して、電磁波の出力を開始する場合に、前記復調ステップにおいてデータを取得するのに、前記第１の閾値より大の第２の閾値以上のレベルの電磁波を必要とする
ことを特徴とする通信方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】

本発明は、通信システム、並びに通信装置および通信方法に関し、特に、例えば、近接通信等の無線通信において生じる、いわゆる隠れ端末問題を容易に解消することができるようにする通信システム、並びに通信装置および通信方法に関する。

【０００２】

【従来の技術】

近接通信を行うシステムとしては、例えば、IC(Integrated Curcuit)システムが広く知られている。ICカードシステムにおいては、リーダ／ライタが電磁波を発生することにより、いわゆるRF(Radio Frequency)フィールド（磁界）を形成する。そして、リーダ／ライタに、ICカードが近づくと、ICカードは、電磁誘導によって、電源の供給を受けるとともに、リーダ／ライタとの間でデータ伝送を行う。

【０００３】

ところで、現在実施されているICカードシステムの仕様としては、例えば、タイプＡ、タイプＢ、タイプＣと呼ばれているものがある。

【０００４】

タイプＡは、フィリップス社のMIFARE方式として採用されているもので、リーダ／ライタからICカードへのデータ伝送には、Millerによるデータのエンコードが行われ、ICカードからリーダ／ライタへのデータ伝送には、Manchesterによるデータのエンコードが行われる。また、タイプＡでは、データの伝送レートとして、106kbps(kilo bit per second)が採用されている。

【０００５】

タイプＢでは、リーダ／ライタからICカードへのデータ伝送には、NRZによるデータのエンコードが行われ、ICカードからリーダ／ライタへのデータ伝送には、NRZ-Lよるデータのエンコードが行われる。また、タイプＢでは、データの伝送レートとして、106kbpsが採用されている。

【０００６】

タイプＣは、本件出願人であるソニー株式会社のFeliCa方式として採用されているもので、リーダ／ライタとICカードとの間のデータ伝送には、Manchesterによるデータのエンコードが行われる。また、タイプＣでは、データの伝送レートとして、212kbpsが採用されている。

【０００７】

ところで、近接通信等の無線通信においては、いわゆる隠れ端末問題が生じるため、それに、どのように対応するかが問題となる。

【０００８】

例えば、従来の無線LAN(Local Area Network)のシステムにおいては、一般に、コマンドRTS(Request to send)とCTS(Clear to send)をデータ通信中にやりとりすることで、隠れ端末問題に対処している（例えば、非特許文献１）。

【０００９】

ここで、隠れ端末問題とは、一般に、以下のような問題をいう。

【００１０】

即ち、無線通信においては、複数の通信装置について、そのうちの一方から他方の通信装置に伝送しようとする際に、同時に電波（電磁波）を出さないように制御が行われる。具体的には、電波を出力しようとしている通信装置は、周囲の電波の検出を行い、周囲に電波が検出された場合には、電波を出力せず、周囲に電波が検出されなかった場合には、電

磁波を出力する。これにより、一方の通信装置と他方の通信装置とは、交互に電波を出し合ってデータをやりとりする。

【００１１】

上述のように、電波を出力しようとしている通信装置が、周囲の電磁波の検出の有無だけによって、自身による電波の出力制御を行う場合、ある通信装置に対して、他の複数の通信装置から同時にデータが送信される状況が発生し、ある通信装置において、データの受信に失敗することがある。

【００１２】

即ち、いま、３つの通信装置Ａ，Ｂ，Ｃが存在するとする。そして、通信装置ＡとＢは、両者の間で電波を排他的に利用制御しうる距離にあるとともに、通信装置ＢとＣも、両者の間で電波を排他的に利用制御しうる距離にあるとする。但し、通信装置ＡとＣは、両者の間で電波を排他的に利用制御しうる距離にないとする。

【００１３】

この場合、通信装置Ｂは、通信装置Ａまたは通信装置Ｃのうちのいずれか一方で電波を出力しているときは、電波を出力することができない。但し、通信装置Ａは、通信装置Ｃが電波を出力していても、電波を出力することができる。通信装置Ｃも、通信装置Ａが電波を出力していても、電波を出力することができる。

【００１４】

通信装置Ａ乃至Ｃが、上述のような位置関係にある場合、通信装置Ｂに対して、通信装置ＡとＣの両方から同時に電波（データ）が送信される場合があり得る。そして、例えば、通信装置Ｂから、通信装置ＡとＣそれぞれまでの距離が等しく、通信装置ＡとＣが同一の強度の電波を出力するとすれば、通信装置Ｂでは、通信装置ＡとＣそれぞれから出力される電波が、同一の強度で受信され、その結果、混信によって、通信装置ＡとＣのいずれから送信されてくるデータも、正常に受信することはできない。

【００１５】

以上のように、通信装置Ｂがデータを正常に受信することができないのは、通信装置Ａからは、通信装置Ｂの存在を確認することができるが、通信装置Ｃの存在を確認することができず、通信装置Ｃからも、通信装置Ｂの存在を確認することができるが、通信装置Ａの存在を確認することができないことに起因する。このように、通信装置ＡとＣそれぞれから、他方が、いわば隠れて見えないことに起因して、通信装置Ｂにおいて、通信装置ＡとＣから同時に電波が出力されることによって混信が生じる問題が、隠れ端末問題と呼ばれる。

【００１６】

そこで、従来の無線LANでは、通信を開始する通信元の通信装置は、通信時間（空間占有時間）等を報知するコマンドRTSを通信相手の通信装置に送信する。

コマンドRTSを受信した通信相手の通信装置は、通信元の通信装置に対して、コマンドRTSに対する了解と通信時間（空間占有時間）等を報知するコマンドCTSを送り返す。通信元または通信相手の通信装置によるコマンドRTSまたはCTSを受信することができる距離にいる他の通信装置は、そのコマンドRTSまたはCTSによって、ある空間占有時間の間の空間の占有を認識し、その空間占有時間の間は、電波（データ）の送信を控える。

【００１７】

上述の位置関係にある通信装置Ａ乃至Ｃにおいては、通信装置Ａが通信装置ＢにコマンドRTSを送信し、通信装置Ｂが、そのコマンドRTSに対する応答としてのコマンドCTSを、通信装置Ａに送信する。通信装置Ｃは、通信装置Ｂが送信したコマンドCTSを受信することが可能であり、通信装置Ｃは、通信装置Ｂが送信したコマンドCTSを受信すると、電波の送出を控え、その結果、通信装置Ｂにおいて、通信装置ＡとＣからの電波（データ）が衝突することを回避することができる。

【００１８】

【非特許文献１】

ANSI/IEEE Std 802.11, 1999 Edition、LOCAL AND METROPOLITAN AREA NETWORKS: WIRELE

SS LAN, Chapter 9　MAC sublayer functional description

【００１９】

【発明が解決しようとする課題】

しかしながら、コマンドRTSとCTSによる隠れ端末問題の解決手法は、通信装置に、そのための制御ロジックやメモリ等を必要とし、コストが上昇する課題があった。

【００２０】

本発明は、このような状況に鑑みてなされたものであり、隠れ端末問題を容易に解消することができるようにするものである。

【００２１】

【課題を解決するための手段】

本発明の通信システムは、第１の通信装置は、検出手段において第１の閾値以上のレベルの電磁波が検出されていない場合に、電磁波の出力を開始し、第２の通信装置は、復調手段においてデータを取得するのに、第１の閾値より大の第２の閾値以上のレベルの電磁波を必要とすることを特徴とする。

【００２２】

本発明の第１の通信装置は、検出手段において第１の閾値以上のレベルの電磁波が検出されていない場合に、電磁波の出力を開始し、その電磁波が、第１の閾値より大の第２の閾値以上のレベルで到達する位置にある他の装置と通信することを特徴とする。

【００２３】

本発明の第１の通信方法は、検出ステップにおいて第１の閾値以上のレベルの電磁波が検出されていない場合に、電磁波の出力を開始し、その電磁波が、第１の閾値より大の第２の閾値以上のレベルで到達する位置にある他の装置と通信することを特徴とする。

【００２４】

本発明の第２の通信装置は、他の装置が、第１の閾値以上のレベルの電磁波が存在しないことを確認して、電磁波の出力を開始する場合に、復調手段においてデータを取得するのに、第１の閾値より大の第２の閾値以上のレベルの電磁波を必要とすることを特徴とする。

【００２５】

本発明の第２の通信方法は、他の装置が、第１の閾値以上のレベルの電磁波が存在しないことを確認して、電磁波の出力を開始する場合に、復調ステップにおいてデータを取得するのに、第１の閾値より大の第２の閾値以上のレベルの電磁波を必要とすることを特徴とする。

【００２６】

本発明の通信システムにおいては、第１の通信装置は、第１の閾値以上のレベルの電磁波が検出されていない場合に、電磁波の出力を開始し、第２の通信装置は、データを取得するのに、第１の閾値より大の第２の閾値以上のレベルの電磁波を必要とする。

【００２７】

本発明の第１の通信装置および通信方法においては、第１の閾値以上のレベルの電磁波が検出されていない場合に、電磁波の出力が開始され、その電磁波が、第１の閾値より大の第２の閾値以上のレベルで到達する位置にある他の装置と通信が行われる。

【００２８】

本発明の第２の通信装置および通信方法においては、他の装置が、第１の閾値以上のレベルの電磁波が存在しないことを確認して、電磁波の出力を開始する場合に、データを取得するのに、第１の閾値より大の第２の閾値以上のレベルの電磁波を必要とする。

【００２９】

【発明の実施の形態】

図１は、本発明を適用した通信システム（システムとは、複数の装置が論理的に結合したもの物をいい、各構成の装置が同一筐体中にあるか否かは問わない）の一実施の形態の構成例を示している。

【００３０】

図１においては、通信システムは、３つのNFC通信装置１，２，３から構成されている。NFC通信装置１乃至３それぞれは、他のNFC通信装置との間で、単一の周波数の搬送波を使用した、電磁誘導による近接通信（NFC(Near Field Communication)）を行うことができるようになっている。

【００３１】

ここで、NFC通信装置１乃至３が使用する搬送波の周波数としては、例えば、ISM(Industrial Scientific Medical)バンドの13.56MHzなどを採用することができる。

【００３２】

また、近接通信とは、通信する装置どうしの距離が、数10cm以内となって可能となる通信を意味し、通信する装置どうし（の筐体）が接触して行う通信も含まれる。

【００３３】

なお、図１の通信システムは、NFC通信装置１乃至３のうちの１以上をリーダ／ライタとするとともに、他の１以上をICカードとするICカードシステムとして採用することができることは勿論、NFC通信装置１乃至３それぞれを、PDA(Personal Digital Assistant)、PC（Personal Computer）、携帯電話、腕時計、ペン等の通信システムとして採用することも可能である。即ち、NFC通信装置１乃至３は、近接通信を行う装置であり、ICカードシステムのICカードやリーダ／ライタなどに限定されるものではない。

【００３４】

NFC通信装置１乃至３は、第１に、２つの通信モードによる通信が可能であることと、第２に、複数の伝送レートによるデータ伝送が可能であることとの２つの特徴を有している。

【００３５】

２つの通信モードとしては、パッシブモードとアクティブモードとがある。いま、NFC通信装置１乃至３のうちの、例えば、NFC通信装置１と２の間の通信に注目すると、パッシブモードでは、上述した従来のICカードシステムと同様に、NFC通信装置１と２のうちの一方のNFC通信装置である、例えば、NFC通信装置１は、自身が発生する電磁波（に対応する搬送波）を変調することにより、他方のNFC通信装置であるNFC通信装置２にデータを送信し、NFC通信装置２は、NFC通信装置１が発生する電磁波（に対応する搬送波）を負荷変調することにより、NFC通信装置１にデータを送信する。

【００３６】

一方、アクティブモードでは、NFC通信装置１と２のいずれも、自身が発生する電磁波（に対応する搬送波）を変調することにより、データを送信する。

【００３７】

ここで、電磁誘導による近接通信を行う場合、最初に電磁波を出力して通信を開始し、いわば通信の主導権を握る装置を、イニシエータと呼ぶ。イニシエータは、通信相手にコマンドを送信し、その通信相手は、そのコマンドに対するレスポンスを返す形で、近接通信が行われるが、イニシエータからのコマンドに対するレスポンスを返す通信相手を、ターゲットと呼ぶ。

【００３８】

例えば、いま、NFC通信装置１が電磁波の出力を開始して、NFC通信装置２との通信を開始したとすると、図２および図３に示すように、NFC通信装置１がイニシエータとなり、NFC通信装置２がターゲットとなる。

【００３９】

そして、パッシブモードでは、図２に示すように、イニシエータであるNFC通信装置１が電磁波を出力し続け、NFC通信装置１は、自身が出力している電磁波を変調することにより、ターゲットであるNFC通信装置２に、データを送信するとともに、NFC通信装置２は、イニシエータであるNFC通信装置１が出力している電磁波を負荷変調することにより、NFC通信装置１に、データを送信する。

【００４０】

一方、アクティブモードでは、図３に示すように、イニシエータであるNFC通信装置１は

、自身がデータを送信する場合に、自身で電磁波の出力を開始し、その電磁波を変調することにより、ターゲットであるNFC通信装置２に、データを送信する。そして、NFC通信装置１は、データの送信終了後は、電磁波の出力を停止する。ターゲットであるNFC通信装置２も、自身がデータを送信する場合に、自身で電磁波の出力を開始し、その電磁波を変調することにより、ターゲットであるNFC通信装置２に、データを送信する。そして、NFC通信装置２は、データの送信終了後は、電磁波の出力を停止する。

【００４１】
なお、NFC通信装置１乃至３が、複数の伝送レートによるデータ伝送が可能であるという第２の特徴点については、後述する。

【００４２】
また、図１では、３つのNFC通信装置１乃至３によって、通信システムが構成されているが、通信システムを構成するNFC通信装置は、３つに限定されるものではなく、２または４以上であっても良い。さらに、通信システムは、NFC通信装置の他、例えば、従来のICカードシステムを構成するICカードやリーダ／ライタなどを含めて構成することも可能である。

【００４３】
次に、図４は、図１のNFC通信装置１の構成例を示している。なお、図１の他のNFC通信装置２および３も、図４のNFC通信装置１と同様に構成されるため、その説明は、省略する。

【００４４】
アンテナ１１は、閉ループのコイルを構成しており、このコイルに流れる電流が変化することで、電磁波を出力する。また、アンテナ１１としてのコイルを通る磁束が変化することで、アンテナ１１に電流が流れる。

【００４５】
受信部１２は、アンテナ１１に流れる電流を受信し、同調と検波を行い、復調部１３に出力する。復調部１３は、受信部１２から供給される信号を復調し、デコード部１４に供給する。デコード部１４は、復調部１３から供給される信号としての、例えばマンチェスタ符号などをデコードし、そのデコードの結果得られるデータを、データ処理部１５に供給する。

【００４６】
データ処理部１５は、デコード部１４から供給されるデータに基づき、所定の処理を行う。また、データ処理部１５は、他の装置に送信すべきデータを、エンコード部１６に供給する。

【００４７】
エンコード部１６は、データ処理部１５から供給されるデータを、例えば、マンチェスタ符号などにエンコードし、選択部１７に供給する。選択部１７は、変調部１９または負荷変調部２０のうちのいずれか一方を選択し、その選択した方に、エンコード部１６から供給される信号を出力する。

【００４８】
ここで、選択部１７は、制御部２１の制御にしたがって、変調部１９または負荷変調部２０を選択する。制御部２１は、通信モードがパッシブモードであり、NFC通信装置１がターゲットとなっている場合は、選択部１７に負荷変調部２０を選択させる。また、制御部２１は、通信モードがアクティブモードである場合、または通信モードがパッシブモードであり、かつ、NFC通信装置１がイニシエータとなっている場合は、選択部１７に変調部１９を選択させる。従って、エンコード部１６が出力する信号は、通信モードがパッシブモードであり、NFC通信装置１がターゲットとなっているケースでは、選択部１７を介して、負荷変調部２０に供給されるが、他のケースでは、選択部１７を介して、変調部１９に供給される。

【００４９】
電磁波出力部１８は、アンテナ１１から、所定の単一の周波数の搬送波（の電磁波）を放

射させるための電流を、アンテナ１１に流す。変調部１９は、電磁波出力部１８がアンテナ１１に流す電流としての搬送波を、選択部１７から供給される信号にしたがって変調する。これにより、アンテナ１１からは、データ処理部１５がエンコード部１６に出力したデータにしたがって搬送波を変調した電磁波が放射される。

【００５０】

負荷変調部２０は、外部からアンテナ１１としてのコイルを見たときのインピーダンスを、選択部１７から供給される信号にしたがって変化させる。他の装置が搬送波としての電磁波を出力することにより、アンテナ１１の周囲にRFフィールド（磁界）が形成されている場合、アンテナ１１としてのコイルを見たときのインピーダンスが変化することにより、アンテナ１１の周囲のRFフィールドも変化する。これにより、他の装置が出力している電磁波としての搬送波が、選択部１７から供給される信号にしたがって変調され、データ処理部１５がエンコード部１６に出力したデータが、電磁波を出力している他の装置に送信される。

【００５１】

ここで、変調部１９および負荷変調部２０における変調方式としては、例えば、振幅変調(ASK(Amplitude Shift Keying))を採用することができる。但し、変調部１９および負荷変調部２０における変調方式は、ASKに限定されるものではなく、PSK(Phase Shift Keying)やQAM(Quadrature Amplitude Modulation)その他を採用することが可能である。また、振幅の変調度についても8%から30%、50%、100%等数値に限定されることはなく、好適なものを選択すれば良い。

【００５２】

制御部２１は、NFC通信装置１を構成する各ブロックを制御する。電源部２２は、NFC通信装置１を構成する各ブロックに、必要な電源を供給する。なお、図４では、制御部２１がNFC通信装置１を構成する各ブロックを制御することを表す線の図示と、電源部２２がNFC通信装置１を構成する各ブロックに電源を供給することを表す線の図示は、図が煩雑になるため、省略してある。

【００５３】

検出部２３は、受信部１２と同様に、アンテナ１１に流れる電流を受信し、その電流に基づいて、閾値設定部２４から供給される所定の閾値以上のレベル（磁束密度）の電磁波がアンテナ１１で受信されているかどうかを検出する。

【００５４】

閾値設定部２４は、検出部２３に検出させる電磁波のレベルの閾値を設定し、検出部２３に供給する。なお、閾値設定部２４は、２つの閾値（後述する搬送波出力抑制判断磁束密度TH1と、動作限界搬送波磁束密度TH2）を設定することができるようになっており、検出部２３は、その２つの閾値のうちの、閾値設定部２４が設定する閾値以上のレベルの電磁波を検出する。但し、NFC通信装置１は、検出部２３の他に、図４において点線で示すように、さらに検出部２５を設けて構成し、検出部２３には、２つの閾値のうちの一方の閾値以上のレベルの電磁波を検出させ、検出部２５には、他方の閾値以上のレベルの電磁波を検出させるようにすることができる。

【００５５】

ここで、上述の場合には、デコード部１４およびエンコード部１６において、前述のタイプＣで採用されているマンチェスタ符号を処理するようにしたが、デコード部１４およびエンコード部１６では、マンチェスタ符号だけでなく、タイプＡで採用されているモディファイドミラーや、タイプＣで採用されているNRZなどの複数種類の符号の中から１つを選択して処理するようにすることが可能である。

【００５６】

次に、図５は、図４の復調部１３の構成例を示している。

【００５７】

図５では、復調部１３は、選択部３１、２以上であるＮ個の復調部３２_1乃至３２_N、および選択部３３から構成されている。

【００５８】
選択部３１は、制御部２１（図４）の制御にしたがい、Ｎ個の復調部３$2_1$乃至３$2_N$の中から、１つの復調部３$2_n$（ｎ＝１，２，・・・，Ｎ）を選択し、その選択した復調部３$2_n$に、受信部１２が出力する信号を供給する。
【００５９】
復調部３$2_n$は、第ｎの伝送レートで送信されてきた信号を復調し、選択部３３に供給する。ここで、復調部３$2_n$と復調部３$2_{n'}$（ｎ≠ｎ’）は、異なる伝送レートで送信されてきた信号を復調する。従って、図５の復調部１３は、第１乃至第ＮのＮ通りの伝送レートで送信されてくる信号を復調することができるようになっている。なお、Ｎ通りの伝送レートとしては、例えば、前述した106kbps，212kbpsの他、より高速な424kbps，848kbpsなどを採用することができる。即ち、Ｎ通りの伝送レートには、例えば、既存のICカードシステムなどの近接通信において既に採用されている伝送レートと、それ以外の伝送レートとを含めることができる。
【００６０】
選択部３３は、制御部２１の制御にしたがい、Ｎ個の復調部３$2_1$乃至３$2_N$の中から、１つの復調部３$2_n$を選択し、その復調部３$2_n$で得られた復調出力を、デコード部１４に供給する。
【００６１】
以上のように構成される復調部１３では、制御部２１（図４）は、例えば、選択部３１に、Ｎ個の復調部３$2_1$乃至３$2_N$を順次選択させ、これにより、復調部３$2_1$乃至３$2_N$それぞれに、受信部１２から選択部３１を介して供給される信号を復調させる。そして、制御部２１は、例えば、受信部１２から選択部３１を介して供給される信号を正常に復調することができた復調部３$2_n$を認識し、その復調部３$2_n$の出力を選択するように、選択部３３を制御する。選択部３３は、制御部２１の制御にしたがい、復調部３$2_n$を選択し、これにより、復調部３$2_n$で得られた正常な復調出力が、デコード部１４に供給される。
【００６２】
従って、復調部１３では、Ｎ通りの伝送レートのうちの任意の伝送レートで伝送されてくる信号を復調することができる。
【００６３】
なお、復調部３$2_1$乃至３$2_N$は、正常に復調を行うことができた場合のみ、復調出力を出力し、正常に復調を行うことができなかった場合には、何も出力しない（例えば、ハイインピーダンスとなる）ようにすることができる。この場合、選択部３３は、復調部３$2_1$乃至３$2_N$の出力すべての論理和をとって、デコード部１４に出力すれば良い。
【００６４】
次に、図６は、図４の変調部１９の構成例を示している。
【００６５】
図６では、変調部１９は、選択部４１、２以上であるＮ個の変調部４$2_1$乃至４$2_N$、および選択部４３から構成されている。
【００６６】
選択部４１は、制御部２１（図４）の制御にしたがい、Ｎ個の変調部４$2_1$乃至４$2_N$の中から、１つの変調部４$2_n$（ｎ＝１，２，・・・，Ｎ）を選択し、その選択した変調部４$2_n$に、選択部１７（図４）が出力する信号を供給する。
【００６７】
変調部４$2_n$は、第ｎの伝送レートでデータの送信が行われるように、選択部４３を介して、アンテナ１１に流れる電流としての搬送波を、選択部４１から供給される信号にしたがって変調する。ここで、変調部４$2_n$と変調部４$2_{n'}$（ｎ≠ｎ’）は、搬送波を、異なる伝送レートで変調する。従って、図６の変調部１９は、第１乃至第ＮのＮ通りの伝送レートでデータを送信することができるようになっている。なお、Ｎ通りの伝送レートとしては、例えば、図５の復調部１３が復調することができるのと同一の伝送レートを採用することができる。

【００６８】
選択部４３は、制御部２１の制御にしたがい、Ｎ個の変調部４２$_{1}$乃至４２$_{N}$の中から、選択部４１が選択するのと同一の変調部４２$_{n}$を選択し、その変調部４２$_{n}$と、アンテナ１１とを電気的に接続する。
【００６９】
以上のように構成される変調部１９では、制御部２１（図４）は、例えば、選択部４１に、Ｎ個の変調部４２$_{1}$乃至４２$_{N}$を順次選択させ、これにより、変調部４２$_{1}$乃至４２$_{N}$それぞれに、選択部４１から供給される信号にしたがい、選択部４３を介して、アンテナ１１に流れる電流としての搬送波を変調させる。
【００７０】
従って、変調部１９では、Ｎ通りの伝送レートのうちの任意の伝送レートでデータが送信されるように、搬送波を変調してデータを送信することができる。
【００７１】
なお、図４の負荷変調部２０は、例えば、図６の変調部１９と同様に構成されるため、その説明は、省略する。
【００７２】
以上から、NFC通信装置１乃至３では、搬送波を、Ｎ通りの伝送レートのうちのいずれかの伝送レートで送信されるデータの信号に変調するとともに、Ｎ通りの伝送レートのうちのいずれかの伝送レートで送信されてくるデータの信号を復調することができる。そして、Ｎ通りの伝送レートには、例えば、上述したように、既存のICカードシステム（FeliCa方式など）などの近接通信において既に採用されている伝送レートと、それ以外の伝送レートとを含めることができる。従って、NFC通信装置１乃至３によれば、それぞれの間では、そのＮ通りの伝送レートのいずれの伝送レートでも、データのやりとりを行うことができる。さらに、NFC通信装置１乃至３によれば、既存のICカードシステムを構成するICカードやリーダ／ライタとの間でも、そのICカードやリーダ／ライタが採用している伝送レートで、データのやりとりを行うことができる。
【００７３】
そして、その結果、NFC通信装置１乃至３を、既存の近接通信が採用されているサービスに導入しても、ユーザが混乱等することはなく、従って、その導入を容易に行うことができる。さらに、将来登場することが予想される高速なデータレートによる近接通信が採用されるサービスにも、既存の近接通信との共存を図りながら、NFC通信装置１乃至３を、容易に導入することができる。
【００７４】
また、NFC通信装置１乃至３では、従来の近接通信で採用されていたパッシブモードの他、自身が電磁波を出力することによってデータを送信するアクティブモードでのデータ伝送が可能であるため、リーダ／ライタ等の他の装置を介さなくても、データのやりとりを直接行うことができる。
【００７５】
次に、図７は、図４の復調部１３の他の構成例を示している。なお、図中、図５における場合と対応する部分については、同一の符号を付してあり、以下では、その説明は、適宜省略する。即ち、図７の復調部１３は、選択部３１が設けられていない他は、図５における場合と基本的に同様に構成されている。
【００７６】
即ち、図７の実施の形態では、受信部１２が出力する信号は、復調部３２$_{1}$乃至３２$_{N}$に、同時に供給され、復調部３２$_{1}$乃至３２$_{N}$では、受信部１２からの信号が同時に復調される。そして、制御部２１は、例えば、受信部１２からの信号を正常に復調することができた復調部３２$_{n}$を認識し、その復調部３２$_{n}$を出力するように、選択部３３を制御する。選択部３３は、制御部２１の制御にしたがい、復調部３２$_{n}$を選択し、これにより、復調部３２$_{n}$で得られた正常な復調出力が、デコード部１４に供給される。
【００７７】

なお、図７の実施の形態では、復調部３２$_1$乃至３２$_N$に、常に、復調動作を行わせる必要がある。これに対して、図５の実施の形態では、復調部３２$_1$乃至３２$_N$のうちの、選択部３１に選択されているものだけに復調動作を行わせ、他のものは動作を停止させておくことができる。従って、装置の消費電力を節約する観点からは、図７よりも、図５の構成の方が有利である。一方、正常な復調出力を早期に得る観点からは、図５よりも、図７の構成の方が有利である。

【００７８】

次に、図８は、図４の復調部１３のさらに他の構成例を示している。

【００７９】

図８では、復調部１３は、可変レート復調部５１とレート検出部５２から構成されている。

【００８０】

可変レート復調部５１は、受信部１２から供給される信号を、レート検出部５２からの指示に応じた伝送レートの信号として復調し、その復調結果を、デコード部１４に供給する。レート検出部５２は、受信部１２から供給される信号の伝送レートを検出し、その伝送レートの信号を復調するように、可変レート復調部５１に指示する。

【００８１】

以上のように構成される復調部５１では、受信部１２が出力する信号が、可変レート復調部５１とレート検出部５２に供給される。レート検出部５２は、受信部１２から供給される信号の伝送レートが、例えば、第１乃至第ＮのＮ通りの伝送レートのうちのいずれであるかを検出し、その伝送レートの信号を復調するように、可変レート復調部５１に指示する。そして、可変レート復調部５１は、受信部１２から供給される信号を、レート検出部５２からの指示に応じた伝送レートの信号として復調し、その復調結果を、デコード部１４に供給する。

【００８２】

次に、NFC通信装置１乃至３は、いずれも、最初に電磁波を出力して通信を開始するイニシエータになり得る。さらに、アクティブモードでは、NFC通信装置１乃至３は、イニシエータとなる場合でも、ターゲットとなる場合でも、自身で電磁波を出力する。

【００８３】

従って、NFC通信装置１乃至３が近接している状態で、そのうちの２以上が同時に電磁波を出力した場合には、コリジョン(collision)が生じ、通信を行うことができなくなる。

【００８４】

そこで、NFC通信装置１乃至３それぞれは、他の装置からの電磁波（によるRFフィールド）が存在するかどうかを検出し、存在しない場合にのみ、電磁波の出力を開始し、これにより、コリジョンを防止するようになっている。ここで、このように、他の装置からの電磁波が存在するかどうかを検出し、存在しない場合にのみ、電磁波の出力を開始する処理を、コリジョンを防止するという目的から、RFCA(RF Collision Avoidance)処理という。

【００８５】

RFCA処理には、イニシエータとなろうとするNFC通信装置（図１では、NFC通信装置１乃至３のうちの１以上）が最初に行う初期RFCA処理と、アクティブモードでの通信中において、電磁波の出力を開始するNFC通信装置が、その開始をしようとするごとに行うレスポンスRFCA処理との２つがある。初期RFCA処理であっても、レスポンスRFCA処理であっても、電磁波の出力を開始する前に、他の装置による電磁波が存在するかどうかを検出し、存在しない場合にのみ、電磁波の出力を開始するという点は同一である。但し、初期RFCA処理とレスポンスRFCA処理とでは、他の装置による電磁波の存在が検出されなくなってから、電磁波の出力を開始しなければならないタイミングまでの時間等が異なる。

【００８６】

そこで、まず図９を参照して、初期RFCA処理について説明する。

【００８７】

図９は、初期RFCA処理によって出力が開始される電磁波を示している。なお、図９におい

て（後述する図１０も同様）、横軸は時間を表し、縦軸は、NFC通信装置が出力する電磁波のレベルを表す。

【００８８】

イニシエータとなろうとするNFC通信装置は、常時、他の装置による電磁波の検出を行っており、他の装置による電磁波が、時間T_{IDT}＋ｎ×T_{RFW}だけ連続して検出されなかった場合、電磁波の出力を開始し、その出力から時間T_{IRFG}だけ経過した後に、データ（コマンドを含む）の送信(Send Request)を開始する。

【００８９】

ここで、時間T_{IDT}＋ｎ×T_{RFW}におけるT_{IDT}は、初期遅延時間と呼ばれ、搬送波の周波数をf_cで表すこととすると、例えば、４０９６／f_cより大の値が採用される。ｎは、例えば、０以上３以下の整数で、乱数を用いて生成される。T_{RFW}は、RF待ち時間と呼ばれ、例えば、５１２／f_cが採用される。時間T_{IRFG}は、初期ガードタイムと呼ばれ、例えば、５msより大の値が採用される。

【００９０】

なお、電磁波が検出されてはならない時間T_{IDT}＋ｎ×T_{RFW}に、乱数であるｎを採用することにより、複数のNFC通信装置が同一のタイミングで、電磁波の出力を開始してしまう可能性の低減が図られている。

【００９１】

NFC通信装置が、初期RFCA処理によって、電磁波の出力を開始した場合、そのNFC通信装置は、イニシエータとなるが、その際、通信モードとして、アクティブモードが設定されたときには、イニシエータとなったNFC通信装置は、自身のデータの送信を終了した後、電磁波の出力を停止する。一方、通信モードとして、パッシブモードが設定されたときには、イニシエータとなったNFC通信装置は、ターゲットとの通信が完全に完了するまで、初期RFCA処理によって開始した電磁波の出力を、そのまま続行する。

【００９２】

次に、図１０は、レスポンスRFCA処理によって出力が開始される電磁波を示している。

【００９３】

アクティブモードにおいて電磁波を出力しようとするNFC通信装置は、他の装置による電磁波の検出を行い、他の装置による電磁波が、時間T_{ADT}＋ｎ×T_{RFW}だけ連続して検出されなかった場合、電磁波の出力を開始し、その出力から時間T_{ARFG}だけ経過した後に、データの送信(Send Responsese)を開始する。

【００９４】

ここで、時間T_{ADT}＋ｎ×T_{RFW}におけるｎとT_{RFW}は、図９の初期RFCA処理における場合と同一のものである。また、時間T_{ADT}＋ｎ×T_{RFW}におけるT_{ADT}は、アクティブディレイタイムと呼ばれ、例えば、７６８／f_c以上２５５９／f_c以下の値が採用される。時間T_{ARFG}は、アクティブガードタイムと呼ばれ、例えば、１０２４／f_cより大の値が採用される。

【００９５】

図９と図１０から明らかなように、初期RFCA処理によって電磁波の出力を開始するには、少なくとも初期遅延時間T_{IDT}の間、電磁波が存在してはならず、レスポンスRFCA処理によって電磁波の出力を開始するには、少なくともアクティブディレイタイムT_{ADT}の間、電磁波が存在してはならない。

【００９６】

そして、初期遅延時間T_{IDT}は、４０９６／f_cより大の値であるのに対して、アクティブディレイタイムT_{ADT}は、７６８／f_c以上２５５９／f_c以下の値であることから、NFC通信装置がイニシエータになろうとする場合には、アクティブモードでの通信中において電磁波を出力しようとする場合よりも、電磁波が存在しない状態が長時間必要である。逆に言えば、NFC通信装置がアクティブモードでの通信中において電磁波を出力しようとする場合には、イニシエータになろうとする場合よりも、電磁波が存在しない状態になってから、それほど間をおかずに、電磁波を出力しなければならない。これは、次のような理由

による。

【００９７】

即ち、NFC通信装置がアクティブモードで通信を行う場合、一方のNFC通信装置は、自身で電磁波を出力してデータを送信し、その後、電磁波の出力を停止する。そして、他方のNFC通信装置が電磁波の出力を開始し、データを送信する。従って、アクティブモードの通信では、いずれのNFC通信装置も、電磁波の出力を停止していることがある。このため、NFC通信装置がイニシエータになろうとする場合には、そのNFC通信装置の周囲でアクティブモードの通信が行われていないことを確認するために、イニシエータになろうとしているNFC通信装置の周囲で、他の装置が電磁波を出力していないことを、十分な時間確認する必要がある。

【００９８】

これに対して、アクティブモードでは、上述したように、イニシエータが電磁波を出力することにより、ターゲットにデータを送信する。そして、ターゲットは、イニシエータが電磁波の出力を停止してから、電磁波の出力を開始することにより、イニシエータにデータを送信する。その後、イニシエータは、ターゲットが電磁波の出力を停止してから、電磁波の出力を開始することにより、イニシエータにデータを送信し、以下、同様にして、イニシエータとターゲットの間でデータがやりとりされる。

【００９９】

従って、アクティブモードの通信を行っているイニシエータとターゲットの周囲に、イニシエータとなろうとするNFC通信装置が存在する場合に、アクティブモードの通信を行っているイニシエータとターゲットのうちの一方が電磁波の出力を停止してから、他方が電磁波の出力を開始するまでの時間が長いと、その間は電磁波が存在しないため、イニシエータとなろうとするNFC通信装置が、初期RFCA処理によって電磁波の出力を開始する。この場合、先に行われていたアクティブモードの通信が妨げられることになる。

【０１００】

このため、アクティブモードの通信中に行われるレスポンスRFCA処理では、電磁波が存在しない状態になってから、それほど間をおかずに、電磁波を出力しなければならないようにしている。

【０１０１】

次に、イニシエータになろうとするNFC通信装置は、図９で説明したように、初期RFCA処理によって電磁波の出力を開始し、その後、データの送信を行う。イニシエータになろうとするNFC通信装置は、電磁波の出力を開始することで、イニシエータとなり、そのイニシエータに近接する位置に存在するNFC通信装置はターゲットとなるが、イニシエータが、ターゲットとデータのやりとりをするには、そのデータをやりとりするターゲットを特定しなければならない。このため、イニシエータは、初期RFCA処理によって電磁波の出力を開始した後に、そのイニシエータに近接する位置に存在する１以上のターゲットに対して、各ターゲットを特定する情報としてのNFCID(NFC Identification)を要求する。そして、イニシエータに近接する位置に存在するターゲットは、イニシエータからの要求に応じて、自身を特定するNFCIDを、イニシエータに送信する。

【０１０２】

イニシエータは、以上のようにしてターゲットから送信されてくるNFCIDによってターゲットを特定し、その特定したターゲットとの間で、データのやりとりを行うが、イニシエータが、その周囲（近接する位置）に存在するターゲットを、そのNFCIDによって特定する処理は、SDD(Single Device Detection)処理と呼ばれる。

【０１０３】

ここで、SDD処理において、イニシエータは、ターゲットのNFCIDを要求するが、この要求は、イニシエータが、ポーリングリクエストフレームと呼ばれるフレームを送信することによって行われる。ターゲットは、ポーリングリクエストフレームを受信すると、例えば、自身のNFCIDを乱数によって決定し、そのNFCIDを配置したポーリングレスポンスフレームと呼ばれるフレームを送信する。イニシエータは、ターゲットから送信されてくるポー

リングレスポンスフレームを受信することで、ターゲットのNFCIDを認識する。

【０１０４】

ところで、イニシエータが、その周囲のターゲットに対して、そのNFCIDを要求した場合、イニシエータの周囲に、複数のターゲットが存在するときには、その複数のターゲットの２以上から、同時に、NFCIDが送信されてくることがあり得る。この場合、その２以上のターゲットから送信されてくるNFCIDがコリジョンし、イニシエータは、そのコリジョンしたNFCIDを認識することができない。

【０１０５】

そこで、SDD処理は、NFCIDのコリジョンをなるべく避けるために、例えば、タイムスロットを用いた方法で行われる。

【０１０６】

即ち、図１１は、タイムスロットを用いた方法により行われるSDD処理のシーケンスを示している。なお、図１１では、イニシエータの周囲に、５つのターゲット＃１，＃２，＃３，＃４，＃５が存在するものとしてある。

【０１０７】

SDD処理では、イニシエータがポーリングリクエストフレームを送信するが、その送信の完了後、所定の時間T_dだけおいて、所定の時間T_sの幅のタイムスロットが設けられる。なお、時間T_dは、例えば、５１２×６４／f_cとされ、タイムスロットの幅としての時間T_sは、例えば、２５６×６４／f_cとされる。また、タイムスロットは、例えば、時間的に最も先行するものから、０からのシーケンシャルな番号（整数）が付されることによって特定される。

【０１０８】

ここで、図１１では、タイムスロット＃０，＃１，＃２，＃３の４つを示してあるが、タイムスロットは、例えば、１６まで設けることが可能である。あるポーリングリクエストフレームに対して設けられるタイムスロットの数TSNは、イニシエータが指定し、ポーリングリクエストフレームに含められて、ターゲットに送信される。

【０１０９】

ターゲットは、イニシエータから送信されてくるポーリングリクエストフレームを受信し、そのポーリングリクエストフレームに配置されているタイムスロットの数TSNを認識する。さらに、ターゲットは、０以上TSN－１の範囲の整数Ｒを、乱数により生成し、その整数Ｒによって特定されるタイムスロット＃Ｒのタイミングで、自身のNFCIDを配置したポーリングレスポンスフレームを送信する。

【０１１０】

以上のように、ターゲットは、ポーリングレスポンスフレームを送信するタイミングとしてのタイムスロットを、乱数により決定するので、複数のターゲットがポーリングレスポンスフレームを送信するタイミングがばらつくこととなり、これにより、複数のターゲットが送信するポーリングレスポンスフレームどうしのコリジョンをなるべく避けることができる。

【０１１１】

なお、ターゲットにおいて、ポーリングレスポンスフレームを送信するタイミングとしてのタイムスロットを、乱数により決定しても、複数のターゲットがポーリングレスポンスフレームを送信するタイムスロットが一致し、これにより、ポーリングレスポンスフレームのコリジョンが生じる場合がある。図１１の実施の形態では、タイムスロット＃０において、ターゲット＃４のポーリングレスポンスフレームが、タイムスロット＃１において、ターゲット＃１と＃３のポーリングレスポンスフレームが、タイムスロット＃２において、ターゲット＃５のポーリングレスポンスフレームが、タイムスロット＃３において、ターゲット＃２のポーリングレスポンスフレームが、それぞれ送信されており、ターゲット＃１と＃３のポーリングレスポンスフレームがコリジョンを生じている。

【０１１２】

この場合、イニシエータは、コリジョンを生じているターゲット＃１と＃３のポーリング

レスポンスフレームを正常に受信することができない。そのため、イニシエータは、再度、ポーリングリクエストフレームを送信し、これにより、ターゲット＃１と＃３に対して、それぞれのNFCIDが配置されたポーリングレスポンスフレームの送信を要求する。以下、イニシエータにおいて、その周囲にあるターゲット＃１乃至＃５すべてのNFCIDを認識することができるまで、イニシエータによるポーリングリクエストフレームの送信と、ターゲットによるポーリングレスポンスフレームの送信とが繰り返し行われる。

【０１１３】
なお、イニシエータが、ポーリングリクエストフレームを再度送信した場合に、すべてのターゲット＃１乃至＃５が、ポーリングレスポンスフレームを返すこととすると、再び、ポーリングレスポンスフレームどうしがコリジョンを起こす可能性がある。そこで、ターゲットにおいては、イニシエータからポーリングリクエストフレームを受信した後、それほど時間をおかずに、ポーリングリクエストフレームを再度受信した場合には、例えば、そのポーリングリクエストを無視するようにすることができる。但し、この場合、図１１の実施の形態では、最初に送信されたポーリングリクエストフレームに対して、ポーリングレスポンスのコリジョンを生じているターゲット＃１と＃３については、イニシエータは、そのターゲット＃１と＃３のNFCIDを認識することができないので、ターゲット＃１または＃３との間でのデータのやりとりは、できないことになる。

【０１１４】
そこで、イニシエータが、ポーリングレスポンスフレームを正常に受信し、そのNFCIDを認識することができたターゲット＃２，＃４，＃５については、後述するように、通信対象から一時的にはずし、これにより、ポーリングリクエストフレームに対する応答としてのポーリングレスポンスフレームを返さないようにすることができる。この場合、イニシエータが送信する再度のポーリングリクエストフレームに対して、ポーリングレスポンスフレームを返してくるのは、最初のポーリングリクエストフレームの送信によってNFCIDを認識することができなかったターゲット＃１と＃３だけとなる。従って、この場合、ポーリングレスポンスフレームどうしがコリジョンを起こす可能性を小さくしながら、ターゲット＃１乃至＃５すべてのNFCIDを認識することが可能となる。

【０１１５】
また、ここでは、ターゲットは、上述したように、ポーリングリクエストフレームを受信すると、自身のNFCIDを、乱数によって決定（生成）する。このため、異なるターゲットから、同一のNFCIDがポーリングレスポンスフレームに配置されて、イニシエータに送信されてくる場合があり得る。イニシエータにおいて、異なるタイムスロットにおいて、同一のNFCIDが配置されたポーリングレスポンスフレームが受信された場合、イニシエータには、例えば、ポーリングレスポンスフレームどうしがコリジョンを起こした場合と同様に、ポーリングリクエストフレームを再度送信させることができる。

【０１１６】
ここで、上述したように、NFC通信装置は、既存のICカードシステムを構成するICカードやリーダ／ライタとの間でも、そのICカードやリーダ／ライタが採用している伝送レートで、データのやりとりを行うことができる。いま、ターゲットが、例えば、既存のICカードシステムのICカードである場合、SDD処理は、例えば、次のようにして行われる。

【０１１７】
即ち、イニシエータは、初期RFCA処理により、電磁波の出力を開始し、ターゲットであるICカードは、その電磁波から電源を得て、処理を開始する。つまり、いまの場合、ターゲットは、既存のICカードシステムのICカードであるから、動作するための電源を、イニシエータが出力する電磁波から生成する。

【０１１８】
ターゲットは、電源を得て、動作可能な状態になってから、例えば、最長でも２秒以内に、ポーリングリクエストフレームを受信する準備を行い、イニシエータからポーリングリクエストフレームが送信されてくるのを待つ。

【０１１９】

一方、イニシエータは、ターゲットにおいてポーリングリクエストフレームを受信する準備が整ったかどうかに関係なく、ポーリングリクエストフレームを送信することができる。

【０１２０】
ターゲットは、イニシエータからのポーリングリクエストフレームを受信した場合、上述したように、所定のタイムスロットのタイミングで、ポーリングレスポンスフレームを、イニシエータに送信する。イニシエータは、ターゲットからのポーリングレスポンスフレームを正常受信することができた場合、上述したように、そのターゲットのNFCIDを認識する。一方、イニシエータは、ターゲットからのポーリングレスポンスフレームを正常受信することができなかった場合、ポーリングリクエストフレームを、再度送信することができる。

【０１２１】
なお、いまの場合、ターゲットは、既存のICカードシステムのICカードであるから、動作するための電源を、イニシエータが出力する電磁波から生成する。このため、イニシエータは、初期RFCA処理によって開始した電磁波の出力を、ターゲットとの通信が完全に終了するまで続行する。

【０１２２】
次に、NFC通信装置では、イニシエータがターゲットにコマンドを送信し、ターゲットが、イニシエータからのコマンドに対するレスポンスを送信する（返す）ことで、通信が行われる。

【０１２３】
そこで、図１２は、イニシエータがターゲットに送信するコマンドと、ターゲットがイニシエータに送信するレスポンスとを示している。

【０１２４】
図１２において、アンダーバー(_)の後にREQの文字が記述されているものは、コマンドを表し、アンダーバー(_)の後にRESの文字が記述されているものは、レスポンスを表す。図１２の実施の形態では、コマンドとして、ATR_REQ，WUP_REQ，PSL_REQ，DEP_REQ，DSL_REQ，RLS_REQの６種類が用意されており、コマンドに対するレスポンスとしても、コマンドと同様に、ATR_RES，WUP_RES，PSL_RES，DEP_RES，DSL_RES，RLS_RESの６種類が用意されている。上述したように、イニシエータは、コマンド（リクエスト）をターゲットに送信し、ターゲットは、そのコマンドに対応するレスポンスをイニシエータに送信するので、コマンドは、イニシエータによって送信され、レスポンスは、ターゲットによって送信される。

【０１２５】
コマンドATR_REQは、イニシエータが、ターゲットに対して、自身の属性（仕様）を知らせるとともに、ターゲットの属性を要求するときに、ターゲットに送信される。ここで、イニシエータまたはターゲットの属性としては、そのイニシエータまたはターゲットが送受信することのできるデータの伝送レートなどがある。なお、コマンドATR_REQには、イニシエータの属性の他、そのイニシエータを特定するNFCIDなどが配置され、ターゲットは、コマンドATR_REQを受信することにより、イニシエータの属性とNFCIDを認識する。

【０１２６】
レスポンスATR_REQは、ターゲットが、コマンドATR_REQを受信した場合に、そのコマンドATR_REQに対する応答として、イニシエータに送信される。レスポンスATR_REQには、ターゲットの属性やNFCIDなどが配置される。

【０１２７】
なお、コマンドATR_REQやレスポンスATR_REQに配置される属性としての伝送レートの情報には、イニシエータやターゲットが送受信することのできるデータの伝送レートすべてを含めることができる。この場合、イニシエータとターゲットとの間で、コマンドATR_REQとレスポンスATR_REQのやりとりが１度行われるだけで、イニシエータは、ターゲットが送受信可能な伝送レートを認識することができ、ターゲットも、イニシエータが送受信可

能な伝送レートを認識することができる。

【０１２８】

コマンドWUP_REQは、イニシエータが、通信するターゲットを選択するときに送信される。即ち、後述するコマンドDSL_REQを、イニシエータからターゲットに送信することにより、ターゲットを、ディセレクト(deselect)状態（イニシエータへのデータの送信（レスポンス）を禁止した状態）とすることができるが、コマンドWUP_REQは、そのディセレクト状態を解いて、ターゲットを、イニシエータへのデータの送信を可能にする状態とする場合に送信される。なお、コマンドWUP_REQには、ディセレクト状態を解くターゲットのNFCIDが配置され、コマンドWUP_REQを受信したターゲットのうち、そのコマンドWUP_REQに配置されているNFCIDによって特定されるターゲットが、ディセレクト状態を解く。

【０１２９】

レスポンスWUP_RESは、コマンドWUP_REQを受信したターゲットのうち、そのコマンドWUP_REQに配置されているNFCIDによって特定されるターゲットが、ディセレクト状態を解いた場合にコマンドWUP_REQに対する応答として送信される。

【０１３０】

コマンドPSL_REQは、イニシエータが、ターゲットとの通信に関する通信パラメータを変更するときに送信される。ここで、通信パラメータとしては、例えば、イニシエータとターゲットとの間でやりとりするデータの伝送レートなどがある。

【０１３１】

コマンドPSL_REQには、変更後の通信パラメータの値が配置され、イニシエータからターゲットに送信される。ターゲットは、コマンドPSL_REQを受信し、そこに配置されている通信パラメータの値にしたがって、通信パラメータを変更する。さらに、ターゲットは、コマンドPSL_REQに対するレスポンスPSL_RESを送信する。

【０１３２】

コマンドDEP_REQは、イニシエータが、データ（いわゆる実データ）の送受信（ターゲットとの間のデータ交換）を行うときに送信され、そこには、ターゲットに送信すべきデータが配置される。レスポンスDEP_RESは、ターゲットが、コマンドDEP_REQに対する応答として送信し、そこには、イニシエータに送信すべきデータが配置される。従って、コマンドDEP_REQによって、イニシエータからターゲットにデータが送信され、そのコマンドDEP_REQに対するレスポンスDEP_RESによって、ターゲットからイニシエータにデータが送信される。

【０１３３】

コマンドDSL_REQは、イニシエータが、ターゲットをディセレクト状態とするときに送信される。コマンドDSL_REQを受信したターゲットは、そのコマンドDSL_REQに対するレスポンスDSL_RESを送信してディセレクト状態となり、以後、コマンドWUP_REQ以外のコマンドには反応しなくなる（レスポンスを返さなくなる）。

【０１３４】

コマンドRLS_REQは、イニシエータが、ターゲットとの通信を完全に終了するときに送信される。コマンドRLS_REQを受信したターゲットは、そのコマンドRLS_REQに対するレスポンスRLS_RESを送信し、イニシエータとの通信を完全に終了する。

【０１３５】

ここで、コマンドDSL_REQとRLS_REQは、いずれも、ターゲットを、イニシエータとの通信の対象から解放する点で共通する。しかしながら、コマンドDSL_REQによって解放されたターゲットは、コマンドWUP_REQによって、再び、イニシエータと通信可能な状態となるが、コマンドRLS_REQによって解放されたターゲットは、イニシエータとの間で、上述したポーリングリクエストフレームとポーリングレスポンスフレームのやりとりが行われないと、イニシエータと通信可能な状態とならない。かかる点で、コマンドDSL_REQとRLS_REQは、異なる。

【０１３６】

なお、コマンドとレスポンスのやりとりは、例えば、トランスポート層で行うことができ

る。

【０１３７】
次に、図１３のフローチャートを参照して、NFC通信装置の通信処理について説明する。

【０１３８】
NFC通信装置は、通信を開始する場合、まず最初に、ステップＳ１において、他の装置による電磁波を検出したかどうかを判定する。

【０１３９】
ここで、NFC通信装置（図４）では、制御部２１が、検出部２３での電磁波（NFC通信装置で用いられる電磁波と周波数帯域などが同様の電磁波）の検出結果を監視しており、ステップＳ１では、その検出結果に基づき、他の装置による電磁波を検出したかどうかが判定される。即ち、この場合、図４の閾値設定部２４は、後述する図２４乃至図２６で説明する搬送波出力抑制判断磁束密度TH1を閾値として設定し、検出部２３に供給する。そして、検出部２３は、閾値設定部２４から供給される閾値としての搬送波出力抑制判断磁束密度TH1以上のレベルを検出する。

【０１４０】
ステップＳ１において、他の装置による電磁波が検出されなかったと判定された場合、ステップＳ２に進み、NFC通信装置は、その通信モードを、パッシブモードまたはアクティブモードに設定し、後述するパッシブモードのイニシエータの処理またはアクティブモードのイニシエータの処理を行う。そして、NFC通信装置は、その処理の終了後、ステップＳ１に戻り、以下、同様の処理を繰り返す。

【０１４１】
ここで、ステップＳ２においては、NFC通信装置の通信モードは、上述したように、パッシブモードまたはアクティブモードのうちのいずれに設定してもかまわない。但し、ターゲットが、既存のICカードシステムのICカードなどのパッシブモードのターゲットにしかなり得ない場合は、ステップＳ２では、NFC通信装置は、その通信モードを、パッシブモードに設定し、パッシブモードのイニシエータの処理を行う必要がある。

【０１４２】
一方、ステップＳ１において、他の装置による電磁波が検出されたと判定された場合、即ち、NFC通信装置の周辺で、他の装置による電磁波が検出された場合、ステップＳ３に進み、NFC通信装置は、ステップＳ１で検出された電磁波が検出され続けているかどうかを判定する。

【０１４３】
ステップＳ３において、電磁波が検出され続けていると判定された場合、ステップＳ４に進み、NFC通信装置は、その通信モードを、パッシブモードに設定し、後述するパッシブモードのターゲットの処理を行う。即ち、電磁波が検出され続けている場合というのは、例えば、NFC通信装置に近接する他の装置が、パッシブモードのイニシエータとなって、初期RFCA処理によって出力を開始した電磁波を出力し続けているケースであり、NFC通信装置は、パッシブモードのターゲットとなって処理を行う。そして、その処理の終了後は、ステップＳ１に戻り、以下、同様の処理が繰り返される。

【０１４４】
また、ステップＳ３において、電磁波が検出され続けていないと判定された場合、ステップＳ５に進み、NFC通信装置は、その通信モードを、アクティブモードに設定し、後述するアクティブモードのターゲットの処理を行う。即ち、電磁波が検出され続けていない場合というのは、例えば、NFC通信装置に近接する他の装置が、アクティブモードのイニシエータとなって、初期RFCA処理によって電磁波の出力を開始し、その後、その電磁波の出力を停止したケースであるから、NFC通信装置は、アクティブモードのターゲットとなって処理を行う。そして、その処理の終了後は、ステップＳ１に戻り、以下、同様の処理が繰り返される。

【０１４５】
次に、図１４のフローチャートを参照して、NFC通信装置によるパッシブモードのイニシ

エータの処理について説明する。

【０１４６】

パッシブモードのイニシエータの処理では、まず最初に、ステップＳ１１において、NFC通信装置は、電磁波の出力を開始する。なお、このパッシブモードのイニシエータの処理におけるステップＳ１１は、上述の図１３のステップＳ１において、電磁波が検出されなかった場合に行われる。即ち、NFC通信装置は、図１３のステップＳ１において、電磁波が検出されなかった場合に、ステップＳ１１において、電磁波の出力を開始する。従って、ステップＳ１およびＳ１１の処理が、上述の初期RFCA処理に相当する。

【０１４７】

その後、ステップＳ１２に進み、NFC通信装置は、伝送レートを表す変数ｎを、初期値としての、例えば、１にセットし、ステップＳ１３に進む。ステップＳ１３では、NFC通信装置は、第ｎの伝送レート（以下、適宜、第ｎレートともいう）で、ポーリングリクエストフレームを送信し、ステップＳ１４に進む。ステップＳ１４では、NFC通信装置は、他の装置から、第ｎレートで、ポーリングレスポンスフレームが送信されてきたかどうかを判定する。

【０１４８】

ステップＳ１４において、他の装置から、ポーリングレスポンスフレームが送信されてきていないと判定された場合、即ち、例えば、NFC通信装置に近接する他の装置が、第ｎレートでの通信を行うことができず、第ｎレートで送信したポーリングリクエストフレームに対するポーリングレスポンスフレームが返ってこない場合、ステップＳ１５乃至Ｓ１７をスキップして、ステップＳ１８に進む。

【０１４９】

また、ステップＳ１４において、他の装置から、第ｎレートで、ポーリングレスポンスフレームが送信されてきたと判定された場合、即ち、例えば、NFC通信装置に近接する他の装置が、第ｎレートでの通信を行うことができ、第ｎレートで送信したポーリングリクエストフレームに対するポーリングレスポンスフレームが返ってきた場合、ステップＳ１５に進み、NFC通信装置は、そのポーリングレスポンスフレームを返してきた他の装置をパッシブモードのターゲットとして、そのターゲットのNFCIDを、ポーリングレスポンスフレームに配置されているNFCIDによって認識するとともに、そのターゲットが第ｎレートで通信可能であることを認識する。

【０１５０】

ここで、NFC通信装置は、ステップＳ１５において、パッシブモードのターゲットのNFCIDと、そのターゲットが第ｎレートで通信可能であることを認識すると、そのターゲットとの間の伝送レートを、第ｎレートに（一時的に）決定し、そのターゲットとは、コマンドPSL_REQによって伝送レートが変更されない限り、第ｎレートで通信を行う。

【０１５１】

その後、ステップＳ１６に進み、NFC通信装置は、ステップＳ１５で認識したNFCIDのターゲット（パッシブモードのターゲット）に、コマンドDSL_REQを、第ｎレートで送信し、これにより、そのターゲットが、以後送信されるポーリングリクエストフレームに応答しないように、ディセレクト状態にして、ステップＳ１７に進む。

【０１５２】

ステップＳ１７では、NFC通信装置は、ステップＳ１６で送信したコマンドDSL_REQに対して、そのコマンドDSL_REQによりディセレクト状態とされるターゲットが返してくるレスポンスDSL_RESを受信し、ステップＳ１８に進む。

【０１５３】

ステップＳ１８では、NFC通信装置は、ステップＳ１３でポーリングリクエストフレームを、第ｎレートで送信してから、所定の時間が経過したかどうかを判定する。ここで、ステップＳ１８における所定の時間は、０以上の時間とすることができる。

【０１５４】

ステップＳ１８において、ステップＳ１３でポーリングリクエストフレームを、第ｎレー

トで送信してから、まだ、所定の時間が経過していないと判定された場合、ステップＳ１３に戻り、以下、ステップＳ１３乃至Ｓ１８の処理が繰り返される。

【０１５５】

ここで、ステップＳ１３乃至Ｓ１８の処理が繰り返されることにより、NFC通信装置は、図１１で説明したように、異なるタイムスロットのタイミングで送信されてくるポーリングレスポンスフレームを受信することができる。

【０１５６】

一方、ステップＳ１８において、ステップＳ１３でポーリングリクエストフレームを、第ｎレートで送信してから、所定の時間が経過したと判定された場合、ステップＳ１９に進み、NFC通信装置は、変数ｎが、その最大値であるＮに等しいかどうかを判定する。ステップＳ１９において、変数ｎが、最大値Ｎに等しくないと判定された場合、即ち、変数ｎが最大値Ｎ未満である場合、ステップＳ２０に進み、NFC通信装置は、変数ｎを１だけインクリメントして、ステップＳ１３に戻り、以下、ステップＳ１３乃至Ｓ２０の処理が繰り返される。

【０１５７】

ここで、ステップＳ１３乃至Ｓ２０の処理が繰り返されることにより、NFC通信装置は、Ｎ通りの伝送レートで、ポーリングリクエストフレームを送信するとともに、各伝送レートで返ってくるポーリングレスポンスフレームを受信する。

【０１５８】

一方、ステップＳ１９において、変数ｎが、最大値Ｎに等しいと判定された場合、即ち、NFC通信装置が、Ｎ通りのＮ通りの伝送レートで、ポーリングリクエストフレームを送信するとともに、各伝送レートで返ってくるポーリングレスポンスフレームを受信した場合、ステップＳ２１に進み、NFC通信装置は、パッシブモードのイニシエータとして、その通信処理（パッシブモードのイニシエータの通信処理）を行う。ここで、パッシブモードのイニシエータの通信処理については、後述する。

【０１５９】

そして、パッシブモードのイニシエータの通信処理が終了すると、NFC通信装置は、ステップＳ２１からＳ２２に進み、ステップＳ１１で出力を開始した電磁波の出力を停止し、処理を終了する。

【０１６０】

次に、図１５のフローチャートを参照して、NFC通信装置によるパッシブモードのターゲットの処理について説明する。

【０１６１】

パッシブモードのターゲットの処理では、まず最初に、ステップＳ３１において、NFC通信装置は、伝送レートを表す変数ｎを、初期値としての、例えば、１にセットし、ステップＳ３２に進む。ステップＳ３２では、NFC通信装置は、パッシブモードのイニシエータとなっている他の装置から、第ｎレートで、ポーリングリクエストフレームが送信されてきたかどうかを判定する。

【０１６２】

ステップＳ３２において、パッシブモードのイニシエータから、ポーリングリクエストフレームが送信されてきていないと判定された場合、即ち、例えば、NFC通信装置に近接する他の装置が、第ｎレートでの通信を行うことができず、第ｎレートでポーリングリクエストフレームを送信することができない場合、ステップＳ３３に進み、NFC通信装置は、変数ｎが、その最大値であるＮに等しいかどうかを判定する。ステップＳ３３において、変数ｎが、最大値Ｎに等しくないと判定された場合、即ち、変数ｎが最大値Ｎ未満である場合、ステップＳ３４に進み、NFC通信装置は、変数ｎを１だけインクリメントして、ステップＳ３２に戻り、以下、ステップＳ３２乃至Ｓ３４の処理が繰り返される。

【０１６３】

また、ステップＳ３３において、変数ｎが、最大値Ｎに等しいと判定された場合、ステップＳ３１に戻り、以下、ステップＳ３１乃至Ｓ３４の処理が繰り返される。即ち、ここで

は、パッシブモードのイニシエータから、Ｎ通りの伝送レートのうちのいずれかで送信されてくるポーリングリクエストフレームを受信することができるまで、ステップＳ３１乃至Ｓ３４の処理が繰り返される。

【０１６４】
そして、ステップＳ３２において、パッシブモードのイニシエータから、ポーリングリクエストフレームが送信されてきたと判定された場合、即ち、NFC通信装置が、第ｎレートのポーリングリクエストフレームを正常受信した場合、ステップＳ３５に進み、NFC通信装置は、イニシエータの間の伝送レートを第ｎレートに決定するとともに、乱数によって、自身のNFCIDを生成し、ステップＳ３６に進む。ステップＳ３６では、NFC通信装置は、自身のNFCIDを配置したポーリングレスポンスフレームを、第ｎレートで送信し、ステップＳ３７に進む。

【０１６５】
ここで、NFC通信装置は、ステップＳ３６でポーリングレスポンスフレームを、第ｎレートで送信した後は、パッシブモードのイニシエータからコマンドPSL_REQが送信されてくることによって伝送レートの変更が指示されない限り、第ｎレートで通信を行う。

【０１６６】
ステップＳ３７では、NFC通信装置は、パッシブモードのイニシエータから、コマンドDSL_REQが送信されてきたかどうかを判定し、送信されてきていないと判定した場合、ステップＳ３７に戻り、パッシブモードのイニシエータからコマンドDSL_REQが送信されてくるのを待つ。

【０１６７】
また、ステップＳ３７において、パッシブモードのイニシエータから、コマンドDSL_REQが送信されてきたと判定された場合、即ち、NFC通信装置がコマンドDSL_REQを受信した場合、ステップＳ３８に進み、NFC通信装置は、コマンドDSL_REQに対するレスポンスDSL_REQを送信し、ディセレクト状態となって、ステップＳ３９に進む。

【０１６８】
ステップＳ３９では、NFC通信装置は、パッシブモードのターゲットとして、その通信処理（パッシブモードのターゲットの通信処理）を行い、そのパッシブモードのターゲットの通信処理が終了すると、処理を終了する。なお、パッシブモードのターゲットの通信処理については、後述する。

【０１６９】
次に、図１６のフローチャートを参照して、NFC通信装置によるアクティブモードのイニシエータの処理について説明する。

【０１７０】
アクティブモードのイニシエータの処理では、ステップＳ５１乃至Ｓ６１において、図１４のパッシブモードのイニシエータの処理のステップＳ１１乃至Ｓ２１における場合とそれぞれ同様の処理が行われる。但し、図１４のパッシブモードのイニシエータの処理では、NFC通信装置は、その処理が終了するまで、電磁波を出力し続けるが、アクティブモードのイニシエータの処理では、NFC通信装置は、データを送信するときだけ、電磁波を出力する点が異なる。

【０１７１】
即ち、ステップＳ５１において、NFC通信装置は、電磁波の出力を開始する。
なお、このアクティブモードのイニシエータの処理におけるステップＳ５１は、上述の図１３のステップＳ１において、電磁波が検出されなかった場合に行われる。即ち、NFC通信装置は、図１３のステップＳ１において、電磁波が検出されなかった場合に、ステップＳ５１において、電磁波の出力を開始する。従って、ステップＳ１およびＳ５１の処理が、上述の初期RFCA処理に相当する。

【０１７２】
その後、ステップＳ５２に進み、NFC通信装置は、伝送レートを表す変数ｎを、初期値としての、例えば、１にセットし、ステップＳ５３に進む。ステップＳ５３では、NFC通信

装置は、第ｎレートで、ポーリングリクエストフレームを送信して、電磁波の出力を停止し（以下、適宜、RFオフ処理を行う、ともいう）、ステップＳ５４に進む。

【０１７３】
ここで、ステップＳ５３では、NFC通信装置は、ポーリングリクエストフレームを送信する前に、上述のアクティブRFCA処理によって電磁波の出力を開始する。但し、変数ｎが初期値である１の場合は、ステップＳ１およびＳ５１の処理に対応する初期RFCA処理によって、既に電磁波の出力が開始されているので、アクティブRFCA処理を行う必要はない。

【０１７４】
ステップＳ５４では、NFC通信装置は、他の装置から、第ｎレートで、ポーリングレスポンスフレームが送信されてきたかどうかを判定する。

【０１７５】
ステップＳ５４において、他の装置から、ポーリングレスポンスフレームが送信されてきていないと判定された場合、即ち、例えば、NFC通信装置に近接する他の装置が、第ｎレートでの通信を行うことができず、第ｎレートで送信したポーリングリクエストフレームに対するポーリングレスポンスフレームが返ってこない場合、ステップＳ５５乃至Ｓ５７をスキップして、ステップＳ５８に進む。

【０１７６】
また、ステップＳ５４において、他の装置から、第ｎレートで、ポーリングレスポンスフレームが送信されてきたと判定された場合、即ち、例えば、NFC通信装置に近接する他の装置が、第ｎレートでの通信を行うことができ、第ｎレートで送信したポーリングリクエストフレームに対するポーリングレスポンスフレームが返ってきた場合、ステップＳ５５に進み、NFC通信装置は、そのポーリングレスポンスフレームを返してきた他の装置をアクティブモードのターゲットとして、そのターゲットのNFCIDを、ポーリングレスポンスフレームに配置されているNFCIDによって認識するとともに、そのターゲットが第ｎレートで通信可能であることを認識する。

【０１７７】
ここで、NFC通信装置は、ステップＳ５５において、アクティブモードのターゲットのNFCIDと、そのターゲットが第ｎレートで通信可能であることを認識すると、そのターゲットとの間の伝送レートを、第ｎレートに決定し、そのターゲットとは、コマンドPSL_REQによって伝送レートが変更されない限り、第ｎレートで通信を行う。

【０１７８】
その後、ステップＳ５６に進み、NFC通信装置は、アクティブRFCA処理によって電磁波の出力を開始し、ステップＳ５５で認識したNFCIDのターゲット（アクティブモードのターゲット）に、コマンドDSL_REQを、第ｎレートで送信する。
これにより、そのターゲットは、以後送信されるポーリングリクエストフレーム等に応答しないディセレクト状態となる。その後、NFC通信装置は、RFオフ処理を行い、ステップＳ５６からＳ５７に進む。

【０１７９】
ステップＳ５７では、NFC通信装置は、ステップＳ５６で送信したコマンドDSL_REQに対して、そのコマンドDSL_REQによりディセレクト状態とされるターゲットが返してくるレスポンスDSL_RESを受信し、ステップＳ５８に進む。

【０１８０】
ステップＳ５８では、NFC通信装置は、ステップＳ５３でポーリングリクエストフレームを、第ｎレートで送信してから、所定の時間が経過したかどうかを判定する。

【０１８１】
ステップＳ５８において、ステップＳ５３でポーリングリクエストフレームを、第ｎレートで送信してから、まだ、所定の時間が経過していないと判定された場合、ステップＳ５３に戻り、以下、ステップＳ５３乃至Ｓ５８の処理が繰り返される。

【０１８２】
一方、ステップＳ５８において、ステップＳ５３でポーリングリクエストフレームを、第

ｎレートで送信してから、所定の時間が経過したと判定された場合、ステップＳ５９に進み、NFC通信装置は、変数ｎが、その最大値であるＮに等しいかどうかを判定する。ステップＳ５９において、変数ｎが、最大値Ｎに等しくないと判定された場合、即ち、変数ｎが最大値Ｎ未満である場合、ステップＳ６０に進み、NFC通信装置は、変数ｎを１だけインクリメントして、ステップＳ５３に戻り、以下、ステップＳ５３乃至Ｓ６０の処理が繰り返される。

【０１８３】

ここで、ステップＳ５３乃至Ｓ６０の処理が繰り返されることにより、NFC通信装置は、Ｎ通りの伝送レートで、ポーリングリクエストフレームを送信するとともに、各伝送レートで返ってくるポーリングレスポンスフレームを受信する。

【０１８４】

一方、ステップＳ５９において、変数ｎが、最大値Ｎに等しいと判定された場合、即ち、NFC通信装置が、Ｎ通りのＮ通りの伝送レートで、ポーリングリクエストフレームを送信するとともに、各伝送レートで返ってくるポーリングレスポンスフレームを受信した場合、ステップＳ６１に進み、NFC通信装置は、アクティブモードのイニシエータとして、その通信処理（アクティブモードのイニシエータの通信処理）を行い、その後、処理を終了する。ここで、アクティブモードのイニシエータの通信処理については、後述する。

【０１８５】

次に、図１７のフローチャートを参照して、NFC通信装置によるアクティブモードのターゲットの処理について説明する。

【０１８６】

アクティブモードのターゲットの処理では、ステップＳ７１乃至Ｓ７９において、図１５のパッシブモードのターゲットの処理のステップＳ３１乃至Ｓ３９における場合とそれぞれ同様の処理が行われる。但し、図１５のパッシブモードのターゲットの処理では、NFC通信装置は、パッシブモードのイニシエータが出力する電磁波を負荷変調することによってデータを送信するが、アクティブモードのターゲットの処理では、NFC通信装置は、自身で電磁波を出力してデータを送信する点が異なる。

【０１８７】

即ち、アクティブモードのターゲットの処理では、ステップＳ７１乃至Ｓ７５において、図１５のステップＳ３１乃至Ｓ３５における場合とそれぞれ同一の処理が行われる。

【０１８８】

そして、ステップＳ７５の処理後、ステップＳ７６に進み、NFC通信装置は、アクティブRFCA処理によって電磁波の出力を開始し、自身のNFCIDを配置したポーリングレスポンスフレームを、第ｎレートで送信する。さらに、ステップＳ７６では、NFC通信装置は、RFオフ処理を行い、ステップＳ７７に進む。

【０１８９】

ここで、NFC通信装置は、ステップＳ７６でポーリングレスポンスフレームを、第ｎレートで送信した後は、アクティブモードのイニシエータからコマンドPSL_REQが送信されてくることによって伝送レートの変更が指示されない限り、第ｎレートで通信を行う。

【０１９０】

ステップＳ７７では、NFC通信装置は、アクティブモードのイニシエータから、コマンドDSL_REQが送信されてきたかどうかを判定し、送信されてきていないと判定した場合、ステップＳ７７に戻り、アクティブモードのイニシエータからコマンドDSL_REQが送信されてくるのを待つ。

【０１９１】

また、ステップＳ７７において、アクティブモードのイニシエータから、コマンドDSL_REQが送信されてきたと判定された場合、即ち、NFC通信装置がコマンドDSL_REQを受信した場合、ステップＳ７８に進み、NFC通信装置は、アクティブRFCA処理によって電磁波の出力を開始し、コマンドDSL_REQに対するレスポンスDSL_REQを送信する。さらに、ステップＳ７８では、NFC通信装置は、RFオフ処理を行い、ディセレクト状態となって、ステップ

Ｓ７９に進む。

【０１９２】

ステップＳ７９では、NFC通信装置は、アクティブモードのターゲットとして、その通信処理（アクティブモードのターゲットの通信処理）を行い、そのアクティブモードのターゲットの通信処理が終了すると、処理を終了する。なお、アクティブモードのターゲットの通信処理については、後述する。

【０１９３】

次に、図１８および図１９のフローチャートを参照して、図１４のステップＳ２１におけるパッシブモードのイニシエータの通信処理について説明する。

【０１９４】

パッシブモードのイニシエータであるNFC通信装置は、ステップＳ９１において、通信する装置（以下、適宜、注目装置という）を、図１４のステップＳ１５でNFCIDを認識したターゲットの中から選択し、ステップＳ９２に進む。ステップＳ９２では、コマンドWUP_REQを、注目装置に送信し、これにより、図１４のステップＳ１６でコマンドDSL_REQを送信することによりディセレクト状態とした注目装置の、そのディセレクト状態を解除する（以下、適宜、ウエイクアップする、ともいう）。

【０１９５】

その後、NFC通信装置は、注目装置が、コマンドWUP_REQに対するレスポンスWUP_RESを送信してくるのを待って、ステップＳ９２からＳ９３に進み、そのレスポンスWUP_RESを受信して、ステップＳ９４に進む。ステップＳ９４では、NFC通信装置は、コマンドATR_REQを、注目装置に送信する。そして、NFC通信装置は、注目装置が、コマンドATR_REQに対するレスポンスATR_RESを送信してくるのを待って、ステップＳ９４からＳ９５に進み、そのレスポンスATR_RESを受信する。

【０１９６】

ここで、NFC通信装置および注目装置が、以上のようにして、属性が配置されるコマンドATR_REQとレスポンスATR_RESをやりとりすることで、NFC通信装置および注目装置は、互いに相手が通信可能な伝送レートなどを認識する。

【０１９７】

その後、ステップＳ９５からＳ９６に進み、NFC通信装置は、コマンドDSL_REQを、注目装置に送信し、注目装置を、ディセレクト状態にする。そして、NFC通信装置は、注目装置が、コマンドDSL_REQに対するレスポンスDSL_RESを送信してくるのを待って、ステップＳ９６からＳ９７に進み、そのレスポンスDSL_RESを受信して、ステップＳ９８に進む。

【０１９８】

ステップＳ９８では、NFC通信装置は、図１４のステップＳ１５でNFCIDを認識したターゲットすべてを、ステップＳ９１で注目装置として選択したかどうかを判定する。ステップＳ９８において、NFC通信装置が、まだ、注目装置として選択していないターゲットがあると判定した場合、ステップＳ９１に戻り、NFC通信装置は、まだ、注目装置として選択していないターゲットのうちの１つを新たに注目装置として選択し、以下、同様の処理を繰り返す。

【０１９９】

また、ステップＳ９８において、NFC通信装置が、図１４のステップＳ１５でNFCIDを認識したターゲットすべてを、ステップＳ９１で注目装置として選択したと判定した場合、即ち、NFC通信装置が、NFCIDを認識したターゲットすべてとの間で、コマンドATR_REQとレスポンスATR_RESをやりとりし、これにより、各ターゲットが通信可能な伝送レートなどを認識することができた場合、ステップＳ９９に進み、NFC通信装置は、通信する装置（注目装置）を、ステップＳ９４とＳ９５でコマンドATR_REQとレスポンスATR_RESをやりとりしたターゲットの中から選択し、ステップＳ１００に進む。

【０２００】

ステップＳ１００では、NFC通信装置は、コマンドWUP_REQを、注目装置に送信し、これにより、ステップＳ９６でコマンドDSL_REQを送信することによってディセレクト状態とし

た注目装置をウエイクアップする。そして、NFC通信装置は、注目装置が、コマンドWUP_REQに対するレスポンスWUP_RESを送信してくるのを待って、ステップＳ１００からＳ１０１に進み、そのレスポンスWUP_RESを受信して、図１９のステップＳ１１１に進む。

【０２０１】

ステップＳ１１１では、NFC通信装置は、注目装置と通信を行う際の伝送レートなどの通信パラメータを変更するかどうかを判定する。

【０２０２】

ここで、NFC通信装置は、図１８のステップＳ９５でレスポンスATR_RESを、注目装置から受信しており、そのレスポンスATR_RESに配置された属性に基づき、注目装置が通信可能な伝送レート等の通信パラメータを認識している。NFC通信装置は、例えば、注目装置との間で、現在の伝送レートよりも高速の伝送レートで通信可能な場合、伝送レートをより高速な伝送レートに変更すべく、ステップＳ１１１において、通信パラメータを変更すると判定する。また、NFC通信装置は、例えば、注目装置との間で、現在の伝送レートよりも低速の伝送レートで通信可能であり、かつ、現在の通信環境がノイズレベルの高い環境である場合、伝送エラーを低下するために、伝送レートをより低速な伝送レートに変更すべく、ステップＳ１１１において、通信パラメータを変更すると判定する。なお、NFC通信装置と注目装置との間で、現在の伝送レートと異なる伝送レートで通信可能な場合であっても、現在の伝送レートのままで通信を続行することは可能である。

【０２０３】

ステップＳ１１１において、注目装置と通信を行う際の通信パラメータを変更しないと判定された場合、即ち、NFC通信装置と注目装置との間で、現在の伝送レートなどの現在の通信パラメータのままで、通信を続行する場合、ステップＳ１１２乃至Ｓ１１４をスキップして、ステップＳ１１５に進む。

【０２０４】

また、ステップＳ１１１において、注目装置と通信を行う際の通信パラメータを変更すると判定された場合、ステップＳ１１２に進み、NFC通信装置は、その変更後の通信パラメータの値を、コマンドPSL_REQに配置して、注目装置に送信する。そして、NFC通信装置は、注目装置が、コマンドPSL_REQに対するレスポンスPSL_RESを送信してくるのを待って、ステップＳ１１２からＳ１１３に進み、そのレスポンスPSL_RESを受信して、ステップＳ１１４に進む。

【０２０５】

ステップＳ１１４では、NFC通信装置は、注目装置との通信を行う際の伝送レートなどの通信パラメータを、ステップＳ１１２で送信したコマンドPSL_REQに配置した通信パラメータの値に変更する。NFC通信装置は、以後、注目装置との間で、再び、コマンドPSL_REQとレスポンスPSL_RESのやりとりをしない限り、ステップＳ１１４で変更された値の伝送レートなどの通信パラメータにしたがい、注目装置との通信を行う。

【０２０６】

なお、コマンドPSL_REQとレスポンスPSL_RESのやりとり（ネゴシエーション）によれば、伝送レート以外の、例えば、図４のエンコード部１６（デコード部１４）のエンコード方式や、変調部１９および負荷変調部２０（復調部１３）の変調方式などの変更も行うことが可能である。

【０２０７】

その後、ステップＳ１１５に進み、NFC通信装置は、注目装置との間で送受信すべきデータがあるかどうかを判定し、ないと判定された場合、ステップＳ１１６およびＳ１１７をスキップして、ステップＳ１１８に進む。

【０２０８】

また、ステップＳ１１５において、注目装置との間で送受信すべきデータがあると判定された場合、ステップＳ１１６に進み、NFC通信装置は、コマンドDEP_REQを注目装置に送信する。ここで、ステップＳ１１６では、NFC通信装置は、注目装置に送信すべきデータがある場合には、そのデータを、コマンドDEP_REQに配置して送信する。

【０２０９】
そして、NFC通信装置は、注目装置が、コマンドDEP_REQに対するレスポンスDEP_RESを送信してくるのを待って、ステップＳ１１６からＳ１１７に進み、そのレスポンスDEP_RESを受信して、ステップＳ１１８に進む。
【０２１０】
以上のように、NFC通信装置と注目装置との間で、コマンドDEP_REQとレスポンスDEP_RESがやりとりされることにより、いわゆる実データの送受信が行われる。
【０２１１】
ステップＳ１１８では、NFC通信装置は、通信相手を変更するかどうかを判定する。ステップＳ１１８において、通信相手を変更しないと判定された場合、即ち、例えば、まだ、注目装置との間でやりとりするデータがある場合、ステップＳ１１１に戻り、以下、同様の処理が繰り返される。
【０２１２】
また、ステップＳ１１８において、通信相手を変更すると判定された場合、即ち、例えば、注目装置との間でやりとりするデータはないが、他の通信相手とやりとりするデータがある場合、ステップＳ１１９に進み、NFC通信装置は、コマンドDSL_REQまたはRLS_REQを注目装置に送信する。そして、NFC通信装置は、注目装置が、コマンドDSL_REQまたはRLS_REQに対するレスポンスDSL_RESまたはRLS_RESを送信してくるのを待って、ステップＳ１１９からＳ１２０に進み、そのレスポンスDSL_RESまたはRLS_RESを受信する。
【０２１３】
ここで、上述したように、NFC通信装置が、注目装置に対して、コマンドDSL_REQまたはRLS_REQを送信することにより、その注目装置としてのターゲットは、イニシエータとしてのNFC通信装置との通信の対象から解放される。但し、コマンドDSL_REQによって解放されたターゲットは、コマンドWUP_UPによって、再び、イニシエータと通信可能な状態となるが、コマンドRLS_REQによって解放されたターゲットは、イニシエータとの間で、上述したポーリングリクエストフレームとポーリングレスポンスフレームのやりとりが行われないと、イニシエータと通信可能な状態とならない。
【０２１４】
なお、あるターゲットが、イニシエータとの通信の対象から解放されるケースとしては、上述のように、イニシエータからターゲットに対して、コマンドDSL_REQまたはRLS_REQが送信される場合の他、例えば、イニシエータとターゲットとが離れすぎて、近接通信を行うことができなくなった場合がある。この場合は、コマンドRLS_REQによって解放されたターゲットと同様に、ターゲットとイニシエータとの間で、ポーリングリクエストフレームとポーリングレスポンスフレームのやりとりが行われないと、イニシエータと通信可能な状態とならない。
【０２１５】
ここで、以下、適宜、ターゲットとイニシエータとの間で、ポーリングリクエストフレームとポーリングレスポンスフレームのやりとりが行われないと、イニシエータと通信可能にならないターゲットの解放を、完全解放という。また、イニシエータからコマンドWUP_UPが送信されることによって、再び、イニシエータと通信可能となるターゲットの解放を、一時解放という。
【０２１６】
ステップＳ１２０の処理後は、ステップＳ１２１に進み、NFC通信装置は、図１４のステップＳ１５でNFCIDを認識したターゲットすべてが完全解放されたかどうかを判定する。ステップＳ１２１において、NFCIDを認識したターゲットすべてが、まだ完全解放されていないと判定された場合、図１８のステップ９９に戻り、NFC通信装置は、完全解放されていないターゲット、即ち、一時解放されているターゲットの中から、新たに注目装置を選択し、以下、同様の処理を繰り返す。
【０２１７】
また、ステップＳ１２１において、NFCIDを認識したターゲットすべてが完全解放された

と判定された場合、処理を終了する。

【０２１８】

なお、図１９のステップＳ１１６とＳ１１７において、コマンドDEP_REQとレスポンスDEP_RESがやりとりされることにより、ターゲットとイニシエータとの間で、データの送受信（データ交換）が行われるが、このコマンドDEL_REQとレスポンスDEP_RESのやりとりが、１つのトランザクションである。ステップＳ１１６とＳ１１７の処理後は、ステップＳ１１８，Ｓ１１１，Ｓ１１２，Ｓ１１３を介して、ステップＳ１１４に戻ることが可能であり、通信パラメータを変更することができる。従って、ターゲットとイニシエータとの間の通信に関する伝送レートなどの通信パラメータは、１つのトランザクションごとに変更することが可能である。

【０２１９】

また、ステップＳ１１２とＳ１１３において、イニシエータとターゲットの間で、コマンドPSL_REQとレスポンスPSL_RESをやりとりすることにより、ステップＳ１１４では、通信パラメータの１つであるイニシエータとターゲットの通信モードを変更することが可能である。従って、ターゲットとイニシエータの通信モードは、１つのトランザクションごとに変更することが可能である。なお、このことは、ターゲットとイニシエータの通信モードを、１つのトランザクションの間は、変更してはならないことを意味する。

【０２２０】

次に、図２０のフローチャートを参照して、図１５のステップＳ３８におけるパッシブモードのターゲットの通信処理について説明する。

【０２２１】

パッシブモードのターゲットであるNFC通信装置は、図１５のステップＳ３７およびＳ３８において、パッシブモードのイニシエータとの間で、コマンドDSL_REQとレスポンスDSL_RESのやりとりをしているので、ディセレクト状態となっている。

【０２２２】

そこで、ステップＳ１３１において、NFC通信装置は、イニシエータからコマンドWUP_REQが送信されてきたかどうかを判定し、送信されてきていないと判定した場合、ステップＳ１３１に戻り、ディセレクト状態のままとされる。

【０２２３】

また、ステップＳ１３１において、イニシエータからコマンドWUP_REQが送信されてきたと判定された場合、即ち、NFC通信装置がコマンドWUP_REQを受信した場合、ステップＳ１３１に進み、NFC通信装置は、コマンドWUP_REQに対するレスポンスWUP_RESを送信し、ウエイクアップして、ステップＳ１３３に進む。

【０２２４】

ステップＳ１３３では、NFC通信装置は、コマンドATR_REQが、イニシエータから送信されてきたかどうかを判定し、送信されてきていないと判定した場合、ステップＳ１３４をスキップして、ステップＳ１３５に進む。

【０２２５】

また、ステップＳ１３３において、イニシエータから、コマンドATR_REQが送信されてきたと判定された場合、即ち、NFC通信装置がコマンドATR_REQを受信した場合、ステップＳ１３５に進み、NFC通信装置は、コマンドATR_REQに対するレスポンスATR_RESを送信し、ステップＳ１３５に進む。

【０２２６】

ステップＳ１３５では、NFC通信装置は、コマンドDSL_REQが、イニシエータから送信されてきたかどうかを判定する。ステップＳ１３５において、イニシエータから、コマンドDSL_REQが送信されてきたと判定された場合、即ち、NFC通信装置がコマンドDSL_REQを受信した場合、ステップＳ１３６に進み、NFC通信装置は、コマンドDSL_REQに対するレスポンスDSL_RESを送信し、ステップＳ１３１に戻る。これにより、NFC通信装置は、ディセレクト状態となる。

【０２２７】

一方、ステップＳ１３５において、イニシエータから、コマンドDSL_REQが送信されてきていないと判定された場合、ステップＳ１３７に進み、NFC通信装置は、コマンドPSL_REQが、イニシエータから送信されてきたかどうかを判定し、送信されてきていないと判定した場合、ステップＳ１３８およびＳ１３９をスキップして、ステップＳ１４０に進む。

【０２２８】

また、ステップＳ１３７において、イニシエータから、コマンドPSL_REQが送信されてきたと判定された場合、即ち、NFC通信装置がコマンドPSL_REQを受信した場合、ステップＳ１３８に進み、NFC通信装置は、コマンドPSL_REQに対するレスポンスPSL_RESを送信し、ステップＳ１３９に進む。ステップＳ１３９では、NFC通信装置は、イニシエータからのコマンドPSL_REQにしたがい、その通信パラメータを変更し、ステップＳ１４０に進む。

【０２２９】

ステップＳ１４０では、NFC通信装置は、イニシエータから、コマンドDEP_REQが送信されてきたかどうかを判定し、送信されてきていないと判定した場合、ステップＳ１４１をスキップして、ステップＳ１４２に進む。

【０２３０】

また、ステップＳ１４０において、イニシエータから、コマンドDEP_REQが送信されてきたと判定された場合、即ち、NFC通信装置がコマンドDEP_REQを受信した場合、ステップＳ１４１に進み、NFC通信装置は、コマンドDEP_REQに対するレスポンスDEP_RESを送信し、ステップＳ１４２に進む。

【０２３１】

ステップＳ１４２では、NFC通信装置は、イニシエータから、コマンドRSL_REQが送信されてきたかどうかを判定し、送信されてきていないと判定した場合、ステップＳ１３３に戻り、以下、同様の処理が繰り返される。

【０２３２】

また、ステップＳ１４２において、イニシエータから、コマンドRSL_REQが送信されてきたと判定された場合、即ち、NFC通信装置がコマンドRSL_REQを受信した場合、ステップＳ１４３に進み、NFC通信装置は、コマンドRSL_REQに対するレスポンスRSL_RESを送信し、これにより、イニシエータとの通信を完全に終了して、処理を終了する。

【０２３３】

次に、図２１および図２２は、図１６のステップＳ６１におけるアクティブモードのイニシエータの通信処理の詳細を示すフローチャートである。

【０２３４】

なお、図１８および図１９で説明したパッシブモードのイニシエータの通信処理では、イニシエータが電磁波を出力し続けているが、図２１および図２２のアクティブモードのイニシエータの通信処理では、イニシエータが、コマンドを送信する前に、アクティブRFCA処理を行うことによって電磁波の出力を開始し、コマンドの送信の終了後に、その電磁波の出力を停止する処理（オフ処理）を行う。かかる点を除けば、図２１のアクティブモードのイニシエータの通信処理では、ステップＳ１５１乃至Ｓ１６１と図２２のステップＳ１７１乃至Ｓ１８１において、図１８のステップステップＳ９１乃至Ｓ１０１と図１９のステップＳ１１１乃至Ｓ１２１における場合とそれぞれ同様の処理が行われるため、その説明は、省略する。

【０２３５】

次に、図２３は、図１７のステップＳ７９におけるアクティブモードのターゲットの通信処理の詳細を示すフローチャートである。

【０２３６】

なお、図２０で説明したパッシブモードのターゲットの通信処理では、ターゲットが、イニシエータが出力している電磁波を負荷変調することによってデータを送信するが、図２３のアクティブモードのターゲットの通信処理では、ターゲットが、コマンドを送信する前に、アクティブRFCA処理を行うことによって電磁波の出力を開始し、コマンドの送信の終了後に、その電磁波の出力を停止する処理（オフ処理）を行う。かかる点を除けば、図

２３のアクティブモードのターゲットの通信処理では、ステップＳ１９１乃至Ｓ２０３において、図２０のステップＳ１３１乃至Ｓ１４３における場合とそれぞれ同様の処理が行われるため、その説明は、省略する。
【０２３７】
次に、図２４乃至図２６を参照して、NFC通信装置における隠れ端末問題に対する対処法を説明する。
【０２３８】
図２４は、３つのNFC通信装置１，２，３それぞれの位置と、電磁波のレベル、即ち、ここでは、電磁波による磁束密度の大きさとの関係を示している。
【０２３９】
図２４では、NFC通信装置２は、NFC通信装置１から、ある短い距離L_{12}だけ離れた位置にあり、NFC通信装置３は、NFC通信装置２から、距離L_{12}よりも長い距離L_{23}だけ離れた位置にある。そして、NFC通信装置１と３とは、距離$L_{12}+L_{23}$だけ離れている。
【０２４０】
NFC通信装置１乃至３それぞれは、図４に示したアンテナ１１としてのコイルどうしのトランス結合によって、通信相手との間でデータのやりとりを行う。なお、NFC通信装置の通信相手は、NFC通信装置である必要はなく、従来のICカードなどであってもかまわない。但し、NFC通信装置の通信相手が、従来のICカードなどのように、電力の供給が必要なものである場合は、NFC通信装置は、トランス結合によって、データのやりとりを行う他、電力の供給も行う。
【０２４１】
ところで、コイルどうしのトランス結合により発生する起電力は、そのコイルどうしが近いほど大きく、そのコイルどうしの距離の約３乗に反比例して減衰する傾向がある。
【０２４２】
従って、NFC通信装置１が出力する電磁波による磁束密度は、NFC通信装置１からの距離の約３乗に反比例して単調減少していく。なお、NFC通信装置１が出力する電磁波による磁束密度は、搬送波成分M_{carr1}と、送信するデータの変調分としての信号成分M_{sig1}とに分けることができるが、この搬送波成分M_{carr1}と信号成分M_{sig1}それぞれが、図２４に示すように、NFC通信装置１からの距離の約３乗に反比例して減衰していく。
【０２４３】
同様に、NFC通信装置２と３それぞれが出力する電磁波による磁束密度も、NFC通信装置２と３それぞれからの距離の約３乗に反比例して減衰していく。なお、図２４では（後述する図２５および図２６においても同様）、NFC通信装置２が出力する電磁波による磁束密度の図示は省略してある。また、NFC通信装置３が出力する電磁波による磁束密度については、搬送波成分M_{carr3}のみ図示してあり、信号成分の図示は省略してある。
【０２４４】
NFC通信装置１乃至３は、例えば、図４の復調部１３においてデータを取得するのに、所定の閾値としての動作限界搬送波磁束密度TH2以上（または、より大）の搬送波成分を必要とするように設計されている。
【０２４５】
例えば、いま、NFC通信装置１と２との間で、NFC通信装置１を送信側とするとともに、NFC通信装置２を受信側として、通信が行われるものとすると、図２４では、受信側であるNFC通信装置２は、送信側であるNFC通信装置１が出力する電磁波の搬送波成分M_{carr1}が、動作限界搬送波磁束密度TH2に一致する距離L_{12}だけ離れた位置にあり、NFC通信装置１と通信することができる最も遠い位置に存在している。
【０２４６】
なお、NFC通信装置１と２との間の距離が、距離L_{12}より大となると、NFC通信装置２が受信する、NFC通信装置１からの電磁波の搬送波成分M_{carr1}は、動作限界搬送波磁束密度TH2より小となるから、NFC通信装置２は、NFC通信装置１から送信されてくるデータを受信することができなくなる。このことは、動作限界搬送波磁束密度TH2によって、NFC通信装

置１と２との間で通信することができる距離が、距離L_{12}以下に制限されているということができる。

【０２４７】

また、NFC通信装置２において、その復調部１３（図４）がデータを取得するのに、閾値としての動作限界搬送波磁束密度TH2以上の搬送波成分を必要とするようにするには、例えば、動作限界搬送波磁束密度TH2以上の搬送波成分が、アンテナ１１および受信部１２を介して復調部１３に供給された場合にのみ、復調部１３を動作させる第１の方法や、検出部２３において、動作限界搬送波磁束密度TH2以上の搬送波成分が検出されたときのみ、復調部１３を動作させる第２の方法がある。第２の方法を採用する場合、図４の閾値設定部２４において、動作限界搬送波磁束密度TH2を、閾値として設定し、検出部２３において、その閾値としての動作限界搬送波磁束密度TH2以上のレベルの電磁波を検出するようにすれば良い。

【０２４８】

NFC通信装置１乃至３は、上述したように、復調部１３においてデータを取得するのに、所定の閾値としての動作限界搬送波磁束密度TH2以上のレベルの搬送波成分を必要とするように設計されている他、さらに、他の閾値としての搬送波出力抑制判断磁束密度TH1以上（または、より大）のレベルの搬送波成分が、検出部２３（図４）において検出されていない場合に、電磁波の出力の開始が可能なように設計されている。

【０２４９】

即ち、図９および図１０で説明したように、NFC通信装置１乃至３は、周囲で電磁波が検出されなかった場合に、電磁波の出力を開始するRFCA処理を行うが、このRFCA処理において、電磁波が検出されなかった場合というのは、搬送波出力抑制判断磁束密度TH1以上のレベルの搬送波成分が検出されなかった場合を意味する。

【０２５０】

図２４においては、NFC通信装置１は、通信相手でないNFC通信装置３が出力する電磁波の搬送波成分M_{carr3}が、NFC通信装置１において搬送波出力抑制判断磁束密度TH1未満となる距離$L_{12}+L_{23}$（NFC通信装置１と３の両方が同時に電磁波を出力することができる、NFC通信装置１と３との最小の距離であるとする）だけ離れた位置にある。この場合、NFC通信装置１による電磁波の出力は、NFC通信装置３による電磁波の出力によって妨げられることはない。

【０２５１】

なお、NFC通信装置１と３とが、NFC通信装置３が出力する電磁波の搬送波成分M_{carr3}が、NFC通信装置１において搬送波出力抑制判断磁束密度TH1未満となる距離$L_{12}+L_{23}$だけ離れているということは、NFC通信装置１が出力する電磁波の搬送波成分M_{carr1}も、NFC通信装置３において搬送波出力抑制判断磁束密度TH1未満となるように減衰する。従って、NFC通信装置３による電磁波の出力も、NFC通信装置１による電磁波の出力によって妨げられることはない。なお、ここでは、通信装置１乃至３が出力する電磁波のレベルは、同一であるとする。

【０２５２】

以上のように、図２４では、NFC通信装置２と通信するNFC通信装置１も、NFC通信装置２と通信しようとしていないNFC通信装置３も、電磁波の出力が可能である。そして、NFC通信装置２は、NFC通信装置３に対して、NFC通信装置１よりも近い位置にあり、NFC通信装置１に対しても、NFC通信装置３よりも近い位置にあるから、NFC通信装置３からの電磁波を、NFC通信装置１よりも高いレベルで受信し、NFC通信装置１からの電磁波も、NFC通信装置３よりも高いレベルで受信することになる。

【０２５３】

いま、NFC通信装置１と２との間で通信を行うのであるから、NFC通信装置２が受信するNFC通信装置１からの電磁波が、同じくNFC通信装置２が受信するNFC通信装置３からの電磁波の影響を受ける場合には、NFC通信装置２は、通信相手であるNFC通信装置１からのデータを正常に受信することができず、NFC通信装置３からの電磁波によって、NFC通信装置１

と２との間の通信が妨げられることになる。

【０２５４】

そこで、動作限界搬送波磁束密度TH2は、搬送波出力抑制判断磁束密度TH1より大とされており、これにより、NFC通信装置２が受信するNFC通信装置１からの電磁波における信号成分M_{sig1} が、NFC通信装置２が受信するNFC通信装置３からの電磁波における搬送波成分M_{carr3} からの影響を受けない程度の値にされている。

【０２５５】

以上のように、NFC通信装置１と３との距離が、NFC通信装置３から出力される電磁波における搬送波成分M_{carr3} がNFC通信装置１において搬送波出力抑制判断磁束密度TH1未満に減衰する距離$L_{12}+L_{23}$ である場合に、NFC通信装置２におけるNFC通信装置３による搬送波成分M_{carr3} が影響しない信号成分が得られる搬送波成分の最小レベルを、動作限界搬送波磁束密度TH2とし、NFC通信装置２において、NFC通信装置１からのデータを取得するのに、NFC通信装置１から出力される電磁波として、動作限界搬送波磁束密度TH2以上の搬送波成分M_{carr1} を必要とすることで、NFC通信装置２において、通信相手でないNFC通信装置３が電磁波を出力することにより、NFC通信装置１から送信されてくる信号成分M_{sig1}としてのデータの正常受信が妨げられることを防止すること、つまり、隠れ端末問題を解消することができる。

【０２５６】

即ち、図２４において、NFC通信装置１からの電磁波における搬送波成分M_{carr1} が搬送波出力抑制判断磁束密度TH1未満となる位置にいるNFC通信装置３は、NFC通信装置１が電磁波を出力しているかどうかにかかわらず、電磁波を出力することができる。つまり、NFC通信装置１と３は、同時に、電磁波を出力することができる。

【０２５７】

そして、図２４では、NFC通信装置２は、動作限界搬送波磁束密度TH2の搬送波成分M_{carr1}を、NFC通信装置１から受信するとともに、動作限界搬送波磁束密度TH2より小さい搬送波成分M_{carr3} を、NFC通信装置３から受信する。NFC通信装置２は、他の装置から送信されてくるデータを取得するのに、動作限界搬送波磁束密度TH2以上の搬送波成分を必要とするから、NFC通信装置１から送信されてくるデータは正常受信しうるが、NFC通信装置３から送信されてくるデータは正常受信することができない。さらに、NFC通信装置１と３とが、NFC通信装置３から出力される電磁波における搬送波成分M_{carr3} がNFC通信装置１において搬送波出力抑制判断磁束密度TH1未満に減衰する距離$L_{12}+L_{23}$ だけ離れているから、上述した動作限界搬送波磁束密度TH2の決め方によって、NFC通信装置２がNFC通信装置３から受信する搬送波成分M_{carr3} は、NFC通信装置２がNFC通信装置１から受信する信号成分M_{sig1} に影響しない。従って、NFC通信装置２は、NFC通信装置３が電磁波を出力しているかどうかにかかわらず、NFC通信装置１から送信されてくるデータを正常受信することができる。

【０２５８】

次に、図２５は、図２４に示したNFC通信装置１乃至３の他に、NFC通信装置２’が存在する場合の電磁波のレベルを示している。

【０２５９】

NFC通信装置２’は、NFC通信装置１に対して、NFC通信装置２よりも近い位置であり、かつNFC通信装置３に対して、NFC通信装置２よりも遠い位置に位置している。

【０２６０】

なお、以下、適宜、NFC通信装置＃ｉが出力する電磁波における搬送波成分$M_{carr\#i}$ と信号成分$M_{sig\#i}$ の、NFC通信装置＃ｊにおけるレベル（磁束密度）を、それぞれ、搬送波成分$M_{carr\#i(\#j)}$ と信号成分$M_{sig\#i(\#j)}$ と記載する。

【０２６１】

図２５において、NFC通信装置１と２’とが通信を行うとすると、NFC通信装置２’は、NFC通信装置１に対して、NFC通信装置２よりも近い位置に位置しているので、NFC通信装置２’がNFC通信装置１から受信する搬送波成分$M_{carr1(2')}$ は、NFC通信装置２がNFC通信装

置１から受信する搬送波成分$M_{carr1(2)}$よりも大きい。従って、NFC通信装置２’がNFC通信装置１から受信する信号成分$M_{sig1(2')}$も、NFC通信装置２がNFC通信装置１から受信する信号成分$M_{sig1(2)}$より大きい。

【０２６２】
また、NFC通信装置２’は、NFC通信装置３に対して、NFC通信装置２よりも遠い位置に位置しているので、NFC通信装置２’がNFC通信装置３から受信する搬送波成分$M_{carr3(2')}$は、NFC通信装置２がNFC通信装置３から受信する搬送波成分$M_{carr3(2)}$よりも小さい。

【０２６３】
NFC通信装置１と２が通信を行う場合には、NFC通信装置２がNFC通信装置１から受信する信号成分$M_{sig1(2)}$と、NFC通信装置２がNFC通信装置３から受信する搬送波成分$M_{carr3(2)}$との比がＳＮ(Signal Noise)比となる。同様に、NFC通信装置１と２’が通信を行う場合には、NFC通信装置２’がNFC通信装置１から受信する信号成分$M_{sig1(2')}$と、NFC通信装置２’がNFC通信装置３から受信する搬送波成分$M_{carr3(2')}$との比がＳＮ比となる。

【０２６４】
そして、上述したように、NFC通信装置２’がNFC通信装置１から受信する信号成分$M_{sig1(2')}$は、NFC通信装置２がNFC通信装置１から受信する信号成分$M_{sig1(2)}$より大であり、かつ、NFC通信装置２’がNFC通信装置３から受信する搬送波成分$M_{carr3(2')}$は、NFC通信装置２がNFC通信装置３から受信する搬送波成分$M_{carr3(2)}$より小である。

【０２６５】
従って、NFC通信装置２’のＳＮ比（≡$M_{sig1(2')}$／$M_{carr3(2')}$）は、NFC通信装置２のＳＮ比（≡$M_{sig1(2)}$／$M_{carr3(2)}$）よりも良好になる。

【０２６６】
以上から、NFC通信装置の通信相手であるNFC通信装置２’が、NFC通信装置１に対して、NFC通信装置２よりも近い位置であり、かつNFC通信装置３に対して、NFC通信装置２よりも遠い位置に位置している場合も、隠れ端末問題を解消することができる。

【０２６７】
なお、NFC通信装置２’が、NFC通信装置１に対して、NFC通信装置２よりも遠い位置に位置している場合は、NFC通信装置２’において受信される、NFC通信装置１からの搬送波成分$M_{carr1(2')}$は、動作限界搬送波磁束密度TH2以上にならない。従って、この場合は、そもそも、通信装置１と２’とは通信することができないので、隠れ端末問題は発生しない。

【０２６８】
次に、図２６は、図２４に示したNFC通信装置１乃至３の他に、NFC通信装置３’が存在する場合の電磁波のレベルを示している。

【０２６９】
NFC通信装置３’は、NFC通信装置１と２それぞれに対して、NFC通信装置３よりも遠い位置に位置している。

【０２７０】
従って、NFC通信装置１が出力する電磁波の搬送波成分M_{carr1}は、NFC通信装置３’の位置において、搬送波出力抑制判断磁束密度TH1より小さいレベルに減衰し、NFC通信装置３’が出力する電磁波の搬送波成分$M_{carr3'}$も、NFC通信装置１の位置において、搬送波出力抑制判断磁束密度TH1より小さいレベルに減衰する。このため、NFC通信装置１と３’は、図２４におけるNFC通信装置１と３における場合と同様に、同時に電磁波を出力することができる。

【０２７１】
そして、NFC通信装置３’は、NFC通信装置２に対して、NFC通信装置３よりも遠い位置に位置しているので、NFC通信装置２がNFC通信装置３’から受信する搬送波成分$M_{carr3'(2)}$は、NFC通信装置２がNFC通信装置３から受信する搬送波成分$M_{carr3(2)}$よりも小さい。

【０２７２】
NFC通信装置２がNFC通信装置１と通信する場合、NFC通信装置３や３’が出力する電磁波

は、ノイズに等しく、上述したように、NFC通信装置２がNFC通信装置３’から受信する搬送波成分$M_{carr3'(2)}$は、NFC通信装置２がNFC通信装置３から受信する搬送波成分$M_{carr3(2)}$よりも小さい。

【０２７３】

従って、NFC通信装置２がNFC通信装置１と通信するときのＳＮ比については、NFC通信装置３が電波を出力している場合のＳＮ比（≡$M_{sig1(2)}$／$M_{carr3(2)}$）に比較して、NFC通信装置３’が電波を出力している場合のＳＮ比（≡$M_{sig1(2)}$／$M_{carr3'(2)}$）の方が良好となる。

【０２７４】

以上から、通信相手でないNFC通信装置３’が、通信を行うNFC通信装置１と２それぞれに対して、NFC通信装置３よりも遠い位置に位置していても、隠れ端末問題を解消することができる。

【０２７５】

なお、NFC通信装置３’が、NFC通信装置１に対して、NFC通信装置３よりも近い位置に位置している場合は、NFC通信装置１が出力する電波磁波の搬送波成分M_{carr1}は、搬送波出力抑制判断磁束密度TH1以上のレベルで、NFC通信装置３’に到達する。従って、この場合は、NFC通信装置３’は、電磁波の出力を行うことができない（行わない）ので、隠れ端末問題は発生しない。

【０２７６】

ここで、上述の場合においては、NFC通信装置１が電磁波を出力して、NFC通信装置２に対してデータを送信し、NFC通信装置２が、そのデータを受信するケースについて説明したが、NFC通信装置２が、NFC通信装置１にデータを送信し、NFC通信装置１が、そのデータを受信するケースであっても、NFC通信装置３が電磁波を出力することにより、NFC通信装置１によるデータの受信が妨げられることを防止すること、つまり、隠れ端末問題を解消することができる。

【０２７７】

即ち、NFC通信装置２がパッシブモードのイニシエータである場合、またはアクティブモードで通信を行う場合は、NFC通信装置２は、自身で電磁波を出力してデータを送信する。NFC通信装置３に対して、NFC通信装置１よりも近い位置に位置するNFC通信装置２が電磁波を出力する場合には、その電磁波の搬送波成分は、搬送波出力抑制判断磁束密度TH1より大のレベルで、NFC通信装置３に到達するから、NFC通信装置３は、電磁波の出力をすることができず、隠れ端末問題は発生しない。

【０２７８】

一方、NFC通信装置２がパッシブモードのターゲットである場合、NFC通信装置２は、パッシブモードのイニシエータであるNFC通信装置１が出力する電磁波を負荷変調することにより、データを、NFC通信装置１に送信する。従って、その負荷変調によってNFC通信装置１に到達する信号成分が、NFC通信装置３が出力する電磁波の影響を受ける場合には、NFC通信装置１において、NFC通信装置２から送信されてくるデータを受信することができないこととなる。

【０２７９】

従って、逆に言えば、NFC通信装置１と３が、NFC通信装置３（１）が出力する電磁波の搬送波成分M_{carr3}が搬送波出力抑制判断磁束密度TH1未満となる距離L_{12}＋L_{23}だけ離れている場合に、NFC通信装置１において、NFC通信装置３の搬送波成分M_{carr3}の影響を受けない、NFC通信装置２の負荷変調による信号成分を受信することができれば、NFC通信装置２から送信されてくるデータを受信することができることになる。

【０２８０】

以上から、NFC通信装置２による負荷変調によってNFC通信装置１に到達する信号成分の、NFC通信装置３が出力する電磁波に対するＳＮ比が、十分な大きさとなるように、NFC通信装置２における負荷変調の負荷変調率を設定し、NFC通信装置１と３が、NFC通信装置３（１）が出力する電磁波の搬送波成分M_{carr3}が搬送波出力抑制判断磁束密度TH1未満となる

距離L_{12}＋L_{23}だけ離れている場合に、NFC通信装置１がNFC通信装置２からのデータを、NFC通信装置３からの電磁波に影響されずに正常受信することができる最低限のＳＮ比を確保することができるときの、NFC通信装置２における、NFC通信装置１が出力する電磁波の搬送波成分M_{carr1}を、動作限界搬送波磁束密度TH2とすることにより、隠れ端末問題を解消することができる。

【０２８１】
次に、図２４乃至図２６で説明したようにして、隠れ端末問題を解消して、データの送受信を行う場合の、そのデータの送受信の制御処理（送受信制御処理）について説明する。なお、この送受信制御処理は、例えば、図４の制御部２１によって行われる。

【０２８２】
まず、図２７のフローチャートを参照して、NFC通信装置がパッシブモードのイニシエータとなった場合の、そのパッシブモードのイニシエータの送受信制御処理について説明する。

【０２８３】
まず最初に、ステップＳ２１１において、制御部２１（図４）は、検出部２３において搬送波出力抑制判断磁束密度TH1以上のレベルの電磁波が検出されたかどうかを判定し、検出されたと判定した場合、ステップＳ２１１に戻る。即ち、搬送波出力抑制判断磁束密度TH1以上のレベルの電磁波が検出されている場合には、電磁波を出力することができないので、搬送波出力抑制判断磁束密度TH1以上のレベルの電磁波が検出されたかどうかの判定を続行する。なお、ステップＳ２１１の処理が行われる場合、閾値設定部２４は、検出部２３に供給する閾値を、搬送波出力抑制判断磁束密度TH1に設定して、検出部２３に供給する。

【０２８４】
そして、ステップＳ２１１において、搬送波出力抑制判断磁束密度TH1以上のレベルの電磁波が検出されていないと判定された場合、ステップＳ２１２に進み、制御部２１は、電磁波出力部１８による電磁波の出力と、その電磁波を変調することによるデータの送信を許可し、ステップＳ２１３に進む。これにより、電磁波出力部１８は、電磁波の出力を開始し、また、変調部１９は、電磁波の変調を行うことが可能な状態となる。なお、上述したように、パッシブモードのイニシエータは、ターゲットとの通信が完了するまで、電磁波を出力し続ける。

【０２８５】
ステップＳ２１３では、制御部２１は、自身が出力している電磁波をパッシブモードのターゲットが負荷変調することにより送信されてくるデータの受信と復調を、復調部１３に許可し、ステップＳ２１４に進む。これにより、復調部１３では、パッシブモードのイニシエータが出力している電磁波をパッシブモードのターゲットが負荷変調することにより送信されてくるデータの復調が開始される。

【０２８６】
その後、ステップＳ２１４に進み、制御部２１は、パッシブモードのターゲットとの通信が完全に終了したかどうかを判定し、終了していないと判定した場合、ステップＳ２１４に戻る。また、ステップＳ２１４において、パッシブモードのターゲットとの通信が完全に終了したと判定された場合、制御部２１は、電磁波出力部１８による電磁波の出力、その電磁波を変調することによるデータの送信、および負荷変調された電磁波を復調することによるデータの受信を禁止し、処理を終了する。

【０２８７】
次に、図２８のフローチャートを参照して、NFC通信装置がパッシブモードのターゲットとなった場合の、そのパッシブモードのターゲットの送受信制御処理について説明する。

【０２８８】
まず最初に、ステップＳ２２１において、制御部２１（図４）は、検出部２３において動作限界搬送波磁束密度TH2以上のレベルの電磁波が検出されたかどうかを判定する。なお、ステップＳ２２１の処理が行われる場合、閾値設定部２４は、検出部２３に供給する閾

値を、動作限界搬送波磁束密度TH2に設定して、検出部２３に供給する。
【０２８９】
ステップＳ２２１において、動作限界搬送波磁束密度TH2以上のレベルの電磁波が検出されたと判定された場合、ステップＳ２２２に進み、制御部２１は、パッシブモードのイニシエータから送信されてくる電磁波を復調することによるデータの受信と、その電磁波を負荷変調することによるデータの送信を許可し、ステップＳ２２４に進む。これにより、負荷変調部２０は、電磁波の負荷変調を行うことが可能な状態となり、また、復調部１３は、パッシブモードのイニシエータが出力している電磁波の復調を開始する。
【０２９０】
一方、ステップＳ２２１において、動作限界搬送波磁束密度TH2以上のレベルの電磁波が検出されていないと判定された場合、ステップＳ２２３に進み、制御部２１は、復調部１３により電磁波を復調することによるデータの受信と、負荷変調部２０により電磁波を負荷変調することによるデータの送信を禁止し、ステップＳ２２４に進む。
【０２９１】
ステップＳ２２４では、制御部２１は、パッシブモードのイニシエータとの通信が完全に終了したかどうかを判定し、終了していないと判定した場合、ステップＳ２２１に戻る。また、ステップＳ２２１において、パッシブモードのイニシエータとの通信が完全に終了したと判定された場合、制御部２１は、復調部１３により電磁波を復調することによるデータの受信と、負荷変調部２０により電磁波を負荷変調することによるデータの送信を禁止し、処理を終了する。
【０２９２】
次に、図２９のフローチャートを参照して、NFC通信装置がアクティブモードのイニシエータとなった場合の、そのアクティブモードのイニシエータの送受信制御処理について説明する。
【０２９３】
まず最初に、ステップＳ２３１において、制御部２１（図４）は、検出部２３において搬送波出力抑制判断磁束密度TH1以上のレベルの電磁波が検出されたかどうかを判定する。なお、ステップＳ２３１の処理が行われる場合、閾値設定部２４は、検出部２３に供給する閾値を、搬送波出力抑制判断磁束密度TH1に設定して、検出部２３に供給する。
【０２９４】
ステップＳ２３１において、搬送波出力抑制判断磁束密度TH1以上のレベルの電磁波が検出されたと判定された場合、ステップＳ２３２に進み、制御部２１は、電磁波出力部１８による電磁波の出力と、変調部１９により電磁波を変調することによるデータの送信を禁止し、ステップＳ２３４に進む。即ち、搬送波出力抑制判断磁束密度TH1以上のレベルの電磁波が検出されている場合には、電磁波を出力することができないので、電磁波の出力、ひいては、その電磁波によるデータの送信が禁止される。
【０２９５】
また、ステップＳ２３１において、搬送波出力抑制判断磁束密度TH1以上のレベルの電磁波が検出されていないと判定された場合、ステップＳ２３３に進み、制御部２１は、電磁波出力部１８による電磁波の出力と、その電磁波を変調することによるデータの送信を許可し、ステップＳ２３４に進む。これにより、電磁波出力部１８は、電磁波の出力を開始することが、また、変調部１９は、電磁波の変調を行うことが、それぞれ可能な状態となる。
【０２９６】
ステップＳ２３４では、制御部２１は、検出部２３において動作限界搬送波磁束密度TH2以上のレベルの電磁波が検出されたかどうかを判定する。なお、ステップＳ２３４の処理が行われる場合、閾値設定部２４は、検出部２３に供給する閾値を、動作限界搬送波磁束密度TH2に設定して、検出部２３に供給する。
【０２９７】
ステップＳ２３４において、動作限界搬送波磁束密度TH2以上のレベルの電磁波が検出さ

れたと判定された場合、ステップＳ２３５に進み、制御部２１は、アクティブモードのターゲットから送信されてくる電磁波を復調することによるデータの受信を許可し、ステップＳ２３７に進む。これにより、復調部１３は、アクティブモードのターゲットが出力する電磁波の復調が可能な状態となる。

【０２９８】

一方、ステップＳ２３４において、動作限界搬送波磁束密度TH2以上のレベルの電磁波が検出されていないと判定された場合、ステップＳ２３６に進み、制御部２１は、復調部１３により電磁波を復調することによるデータの受信を禁止し、ステップＳ２３７に進む。

【０２９９】

ステップＳ２３７では、制御部２１は、アクティブモードのターゲットとの通信が完全に終了したかどうかを判定し、終了していないと判定した場合、ステップＳ２３１に戻る。また、ステップＳ２３７において、アクティブモードのターゲットとの通信が完全に終了したと判定された場合、制御部２１は、電磁波出力部１８による電磁波の出力、復調部１３により電磁波を復調することによるデータの受信、および変調部１９により電磁波を変調することによるデータの送信を禁止し、処理を終了する。

【０３００】

次に、図３０は、NFC通信装置がアクティブモードのターゲットとなった場合の、そのアクティブモードのターゲットの送受信制御処理を説明するフローチャートを示している。なお、アクティブモードのターゲットの送受信制御処理では、ステップＳ２４１乃至Ｓ２４７において、図２９のステップＳ２３１乃至Ｓ２３７における場合とそれぞれ同様の処理が行われるため、その説明は、省略する。

【０３０１】

以上のように、NFC通信装置では、搬送波出力抑制判断磁束密度TH1以上のレベルの電磁波が検出されていない場合に、電磁波の出力を開始し、データを正常受信するのに、搬送波出力抑制判断磁束密度TH1より大の動作限界搬送波磁束密度TH2以上のレベルの電磁波を必要とするので、隠れ端末問題を、電磁波の検出だけによって、容易に解消することとができる。

【０３０２】

即ち、NFC通信装置では、前述したコマンドRTSとCTSによる隠れ端末問題の解決手法を採用する場合に必要となる制御ロジックやメモリ等を必要としないので、低コストで、隠れ端末問題を解消することができる。

【０３０３】

さらに、NFC通信装置では、コマンドRTSやCTSをやりとりする必要がないので、隠れ端末問題を、迅速に解消することができる。

【０３０４】

また、NFC通信装置では、データを正常受信するのに、搬送波出力抑制判断磁束密度TH1より大の動作限界搬送波磁束密度TH2以上のレベルの電磁波を必要とするので、通信相手との間でデータを送受信するための距離を、ある一定距離以内に拘束することができる。さらに、アンテナ１１をコイルとして、トランス結合による無線通信路を確立し、NFC通信装置どうしの距離が大となることにより電磁波の減衰も大となるようにしたので、データを正常受信するための通信相手との距離の拘束を強固なもの（必ず守らなければならないもの）とすることができる。

【０３０５】

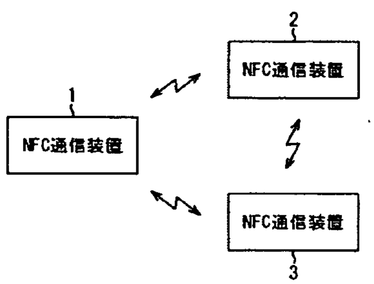
また、上述の場合には、検出部２３において動作限界搬送波磁束密度TH2以上のレベルの電磁波が検出されていない場合には、復調部１３におけるデータの復調を禁止することで、データの受信を行わないようにしたが、その他、NFC通信装置を、従来のICカードなどのように、通信相手からの電力の供給が必要なように構成する場合には、動作限界搬送波磁束密度TH2以上のレベルの電磁波が受信されないと、装置の動作に必要な電力が得られないようにすることで、データの受信に、動作限界搬送波磁束密度TH2以上のレベルの電磁波を必要とするようにすることができる。

【０３０６】
さらに、上述の場合には、閾値設定部２４において、搬送波出力抑制判断磁束密度TH1または動作限界搬送波磁束密度TH2を閾値として設定し、検出部２３において、搬送波出力抑制判断磁束密度TH1と動作限界搬送波磁束密度TH2それぞれ以上のレベルの電磁波の検出を行うようにしたが、図４で説明したように、例えば、検出部２３と２５を設け、それぞれに、搬送波出力抑制判断磁束密度TH1と動作限界搬送波磁束密度TH2それぞれ以上のレベルの電磁波の検出させるようにすることが可能である。但し、検出部２３だけで、搬送波出力抑制判断磁束密度TH1と動作限界搬送波磁束密度TH2以上のレベルの電磁波の検出する方が、検出部２３と２５の２つを設けるより、コスト的に有利である。
【０３０７】
なお、本明細書において、NFC通信装置が行う処理を説明する処理ステップは、必ずしもフローチャートとして記載された順序に沿って時系列に処理する必要はなく、並列的あるいは個別に実行される処理（例えば、並列処理あるいはオブジェクトによる処理）も含むものである。
【０３０８】
また、本実施の形態では、本発明を、複数の伝送レートでのデータの送受信が可能なNFC通信装置に適用した場合について説明したが、本発明は、その他、ある単一の伝送レートでのデータの送受信のみが可能な通信装置などにも適用可能である。
【０３０９】
【発明の効果】
以上の如く、本発明によれば、隠れ端末問題を、容易に解消することが可能となる。
【図面の簡単な説明】
【図１】本発明を適用した通信システムの一実施の形態の構成例を示す図である。
【図２】パッシブモードを説明する図である。
【図３】アクティブモードを説明する図である。
【図４】NFC通信装置１の構成例を示すブロック図である。
【図５】復調部１３の構成例を示すブロック図である。
【図６】変調部１９の構成例を示すブロック図である。
【図７】復調部１３の他の構成例を示すブロック図である。
【図８】復調部１３のさらに他の構成例を示すブロック図である。
【図９】初期RFCA処理を説明するタイミングチャートである。
【図１０】アクティブRFCA処理を説明するタイミングチャートである。
【図１１】SDD処理を説明する図である。
【図１２】コマンドとレスポンスの一覧を示す図である。
【図１３】NFC通信装置の処理を説明するフローチャートである。
【図１４】パッシブモードのイニシエータの処理を示すフローチャートである。
【図１５】パッシブモードのターゲットの処理を示すフローチャートである。
【図１６】アクティブモードのイニシエータの処理を示すフローチャートである。
【図１７】アクティブモードのターゲットの処理を示すフローチャートである。
【図１８】パッシブモードのイニシエータの通信処理を示すフローチャートである。
【図１９】パッシブモードのイニシエータの通信処理を示すフローチャートである。
【図２０】パッシブモードのターゲットの通信処理を示すフローチャートである。
【図２１】アクティブモードのイニシエータの通信処理を示すフローチャートである。
【図２２】アクティブモードのイニシエータの通信処理を示すフローチャートである。
【図２３】アクティブモードのターゲットの通信処理を示すフローチャートである。
【図２４】隠れ端末問題に対する対処を説明する図である。
【図２５】隠れ端末問題に対する対処を説明する図である。
【図２６】隠れ端末問題に対する対処を説明する図である。
【図２７】パッシブモードのイニシエータの送受信制御処理を示すフローチャートである。

【図２８】パッシブモードのターゲットの送受信制御処理を示すフローチャートである。
【図２９】アクティブモードのイニシエータの送受信制御処理を示すフローチャートである。
【図３０】アクティブモードのターゲットの送受信制御処理を示すフローチャートである。

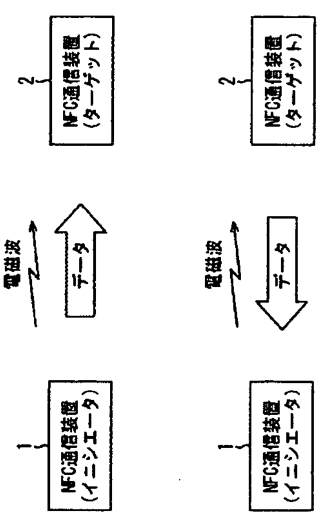
【符号の説明】
１乃至３　NFC通信装置，　１１　アンテナ，　１２　受信部，　１３　復調部，　１４　デコード部，　１５　データ処理部，　１６　エンコード部，　１７　選択部，　１８　電磁波出力部，　１９　変調部，　２０　負荷変調部，　２１　制御部，　２２　電源部，　２３　検出部，　２４　閾値設定部，　２５検出部，　３１　選択部，　３２_1乃至３２_N　復調部，　３３，４１　選択部，　４２_1乃至４２_N　変調部，　４３　選択部，　５１　可変レート復調部，　５２　レート検出部

【図１】
図1



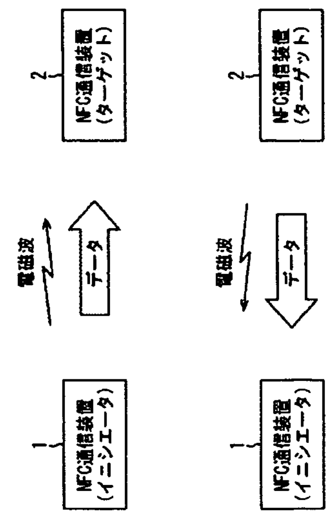
通信システム

【図２】
図2



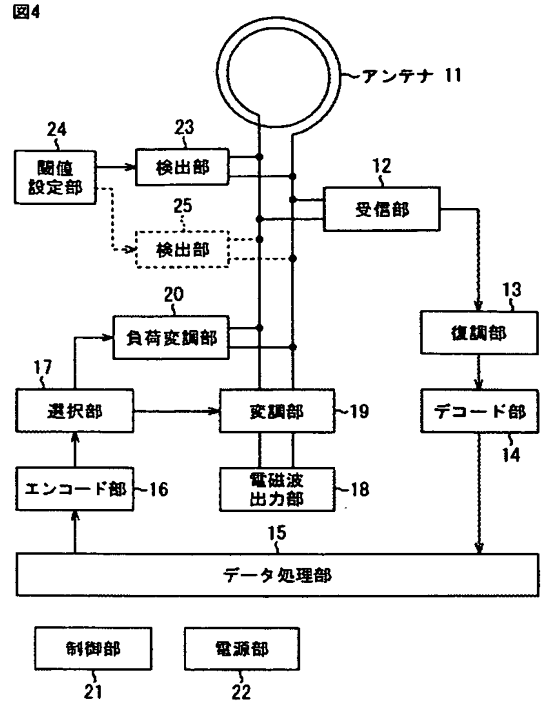
【図３】

図3



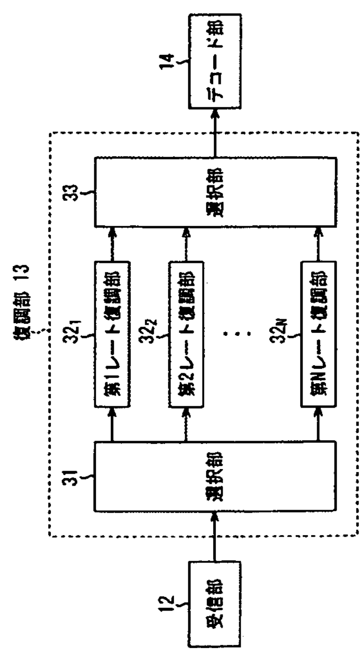
【図４】

図4



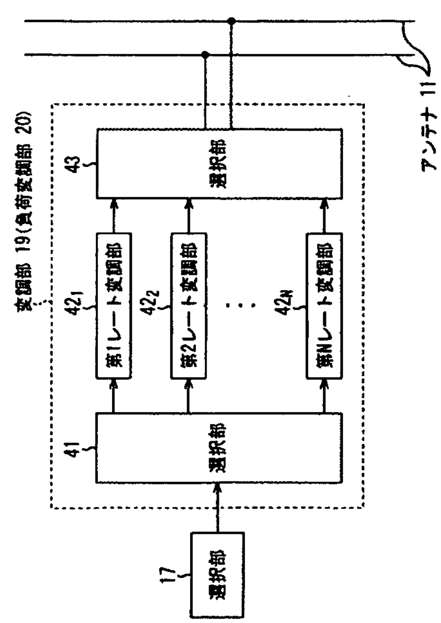
【図５】

図5



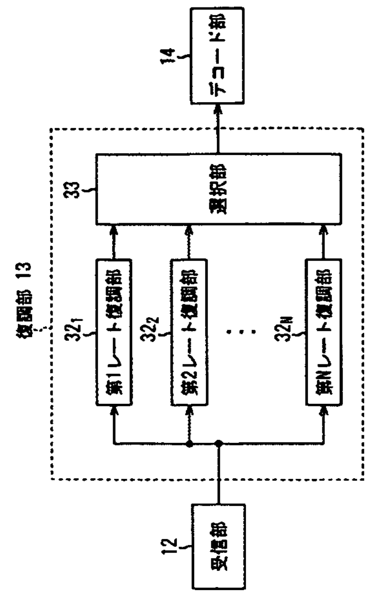
【図６】

図6



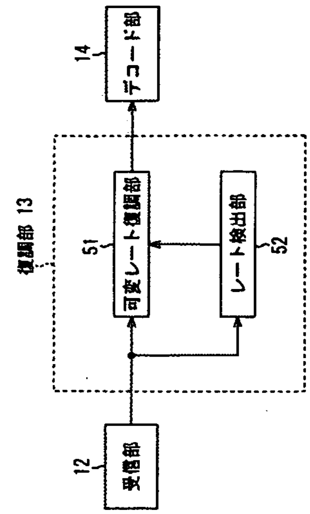
【図7】

図7



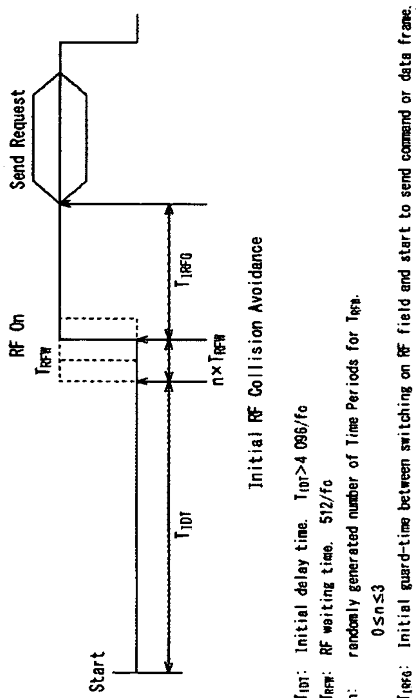
【図8】

図8



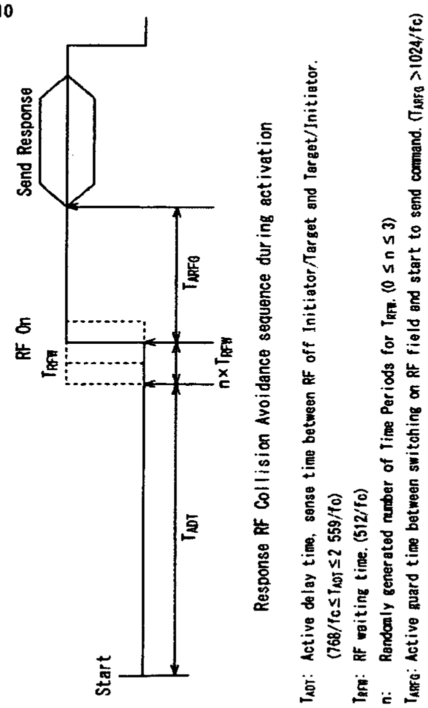
【図9】

図9



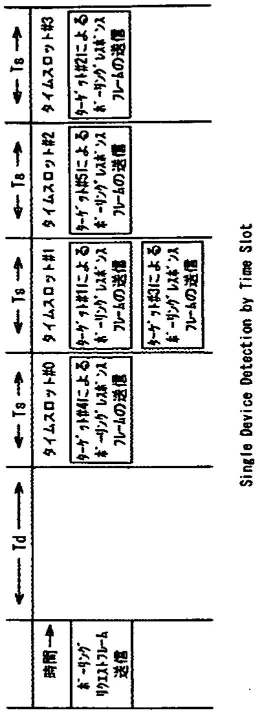
【図10】

図10



【図１１】

図11



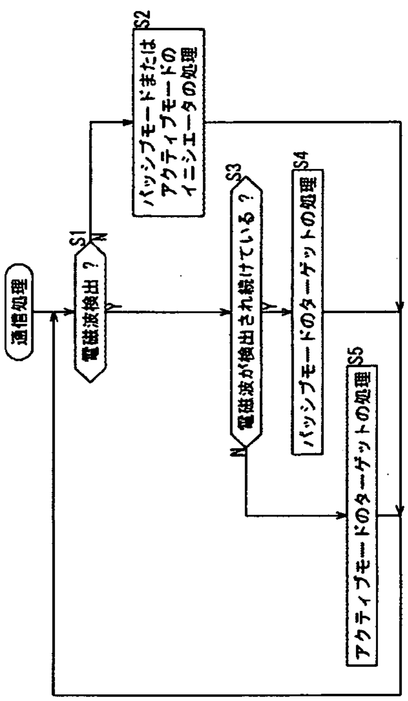
【図１２】

図12

コマンド/レスポンス
ATR_REQ
ATR_RES
WUP_REQ
WUP_RES
PSL_REQ
PSL_RES
DEP_REQ
DEP_RES
DSL_REQ
DSL_RES
RLS_REQ
RLS_RES

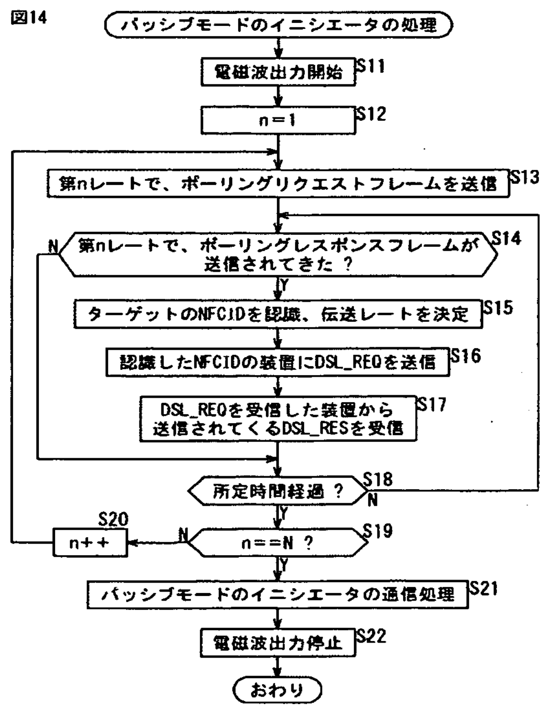
【図１３】

図13

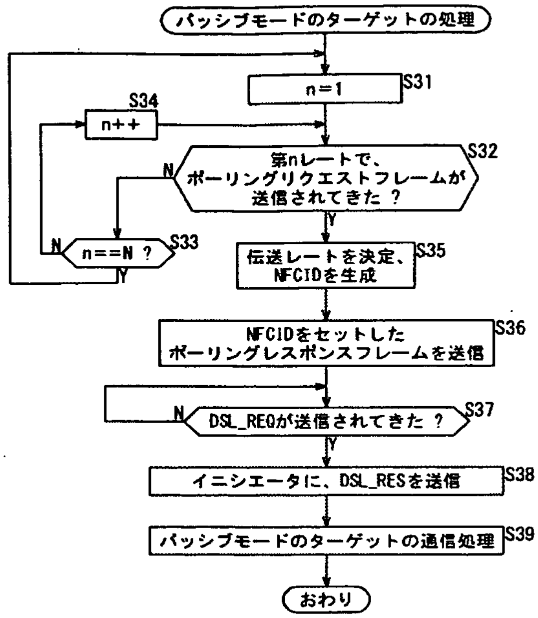


【図１４】

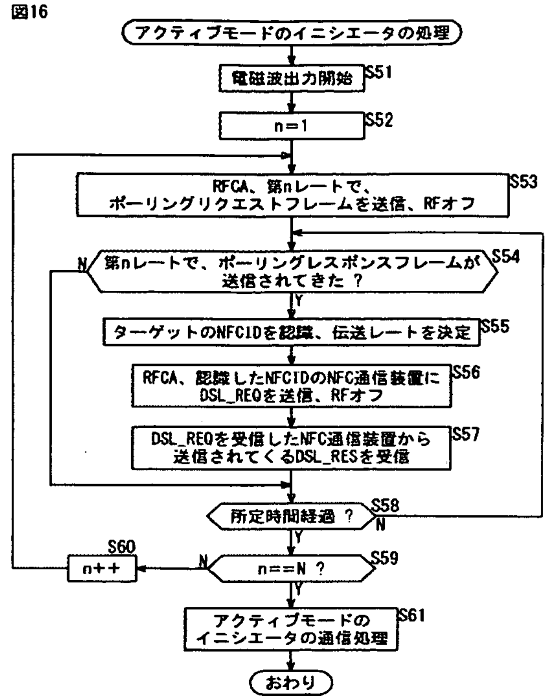
図14



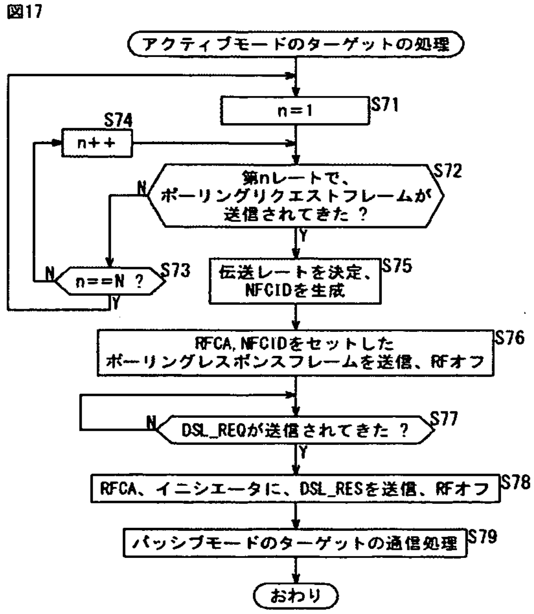
【図１５】



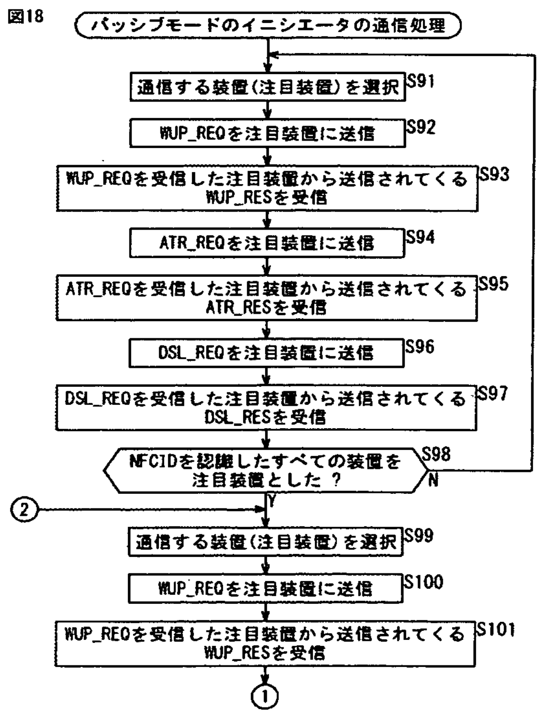
【図１６】



【図１７】

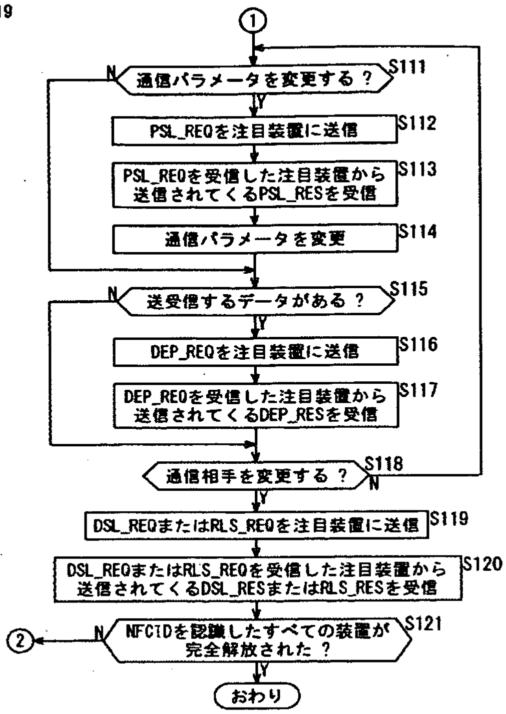


【図１８】



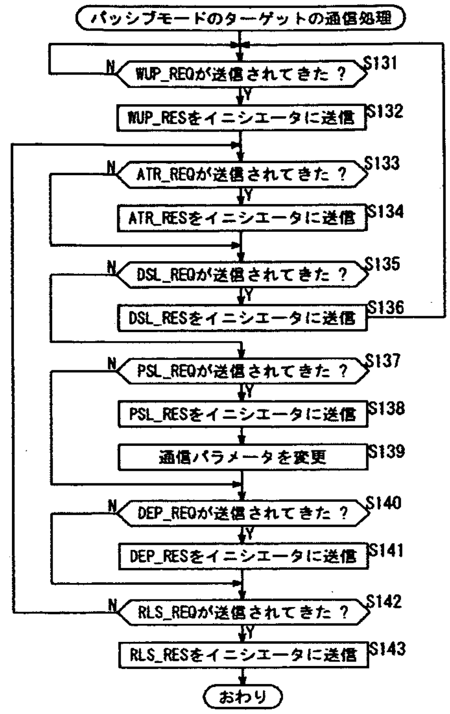
【図１９】

図19



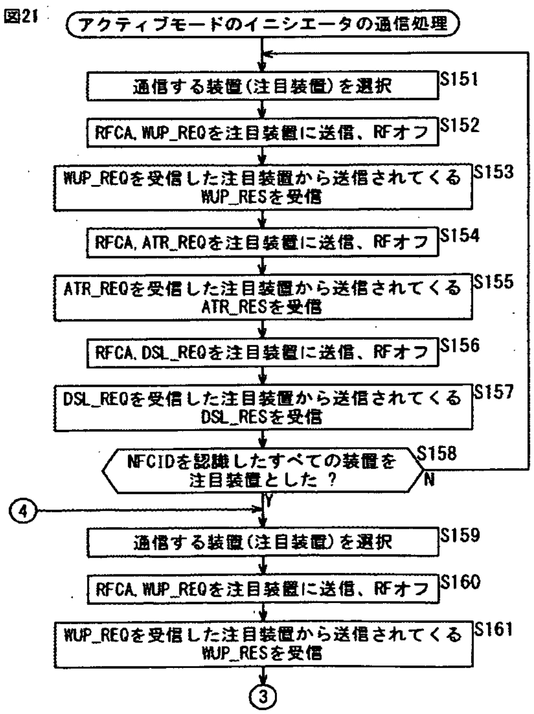
【図２０】

図20



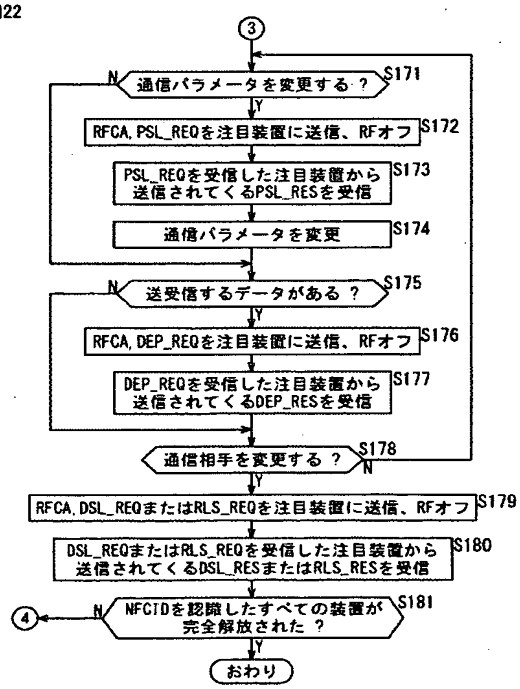
【図２１】

図21



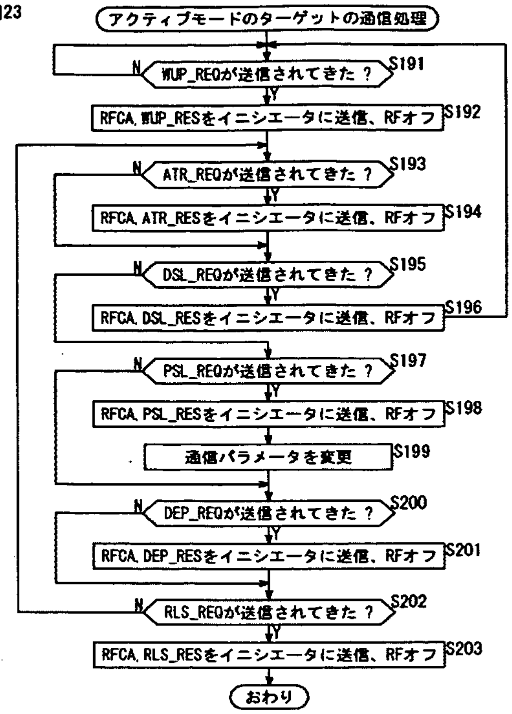
【図２２】

図22



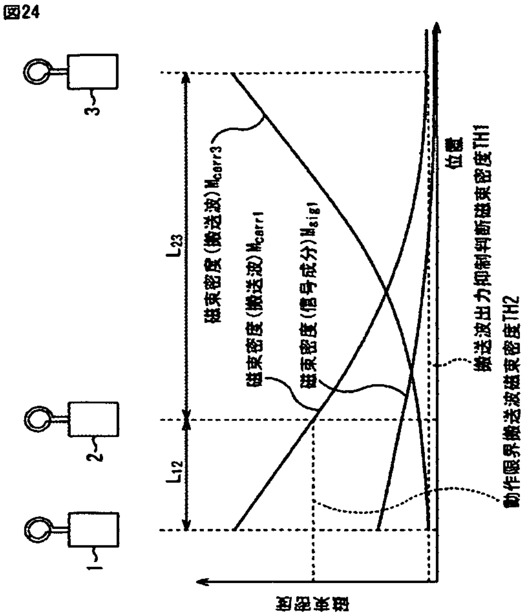
【図２３】

図23



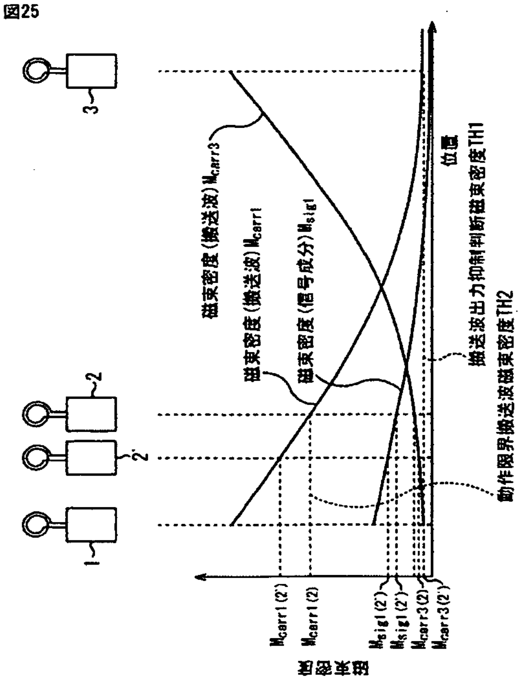
【図２４】

図24



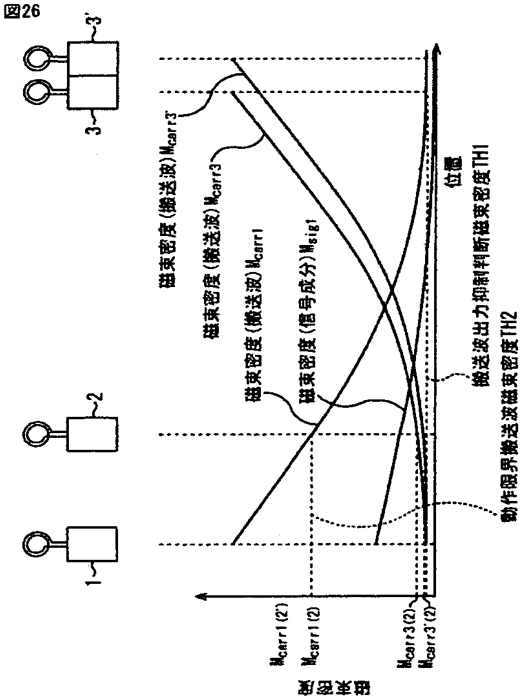
【図２５】

図25



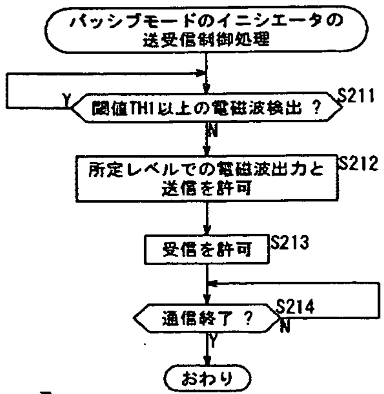
【図２６】

図26



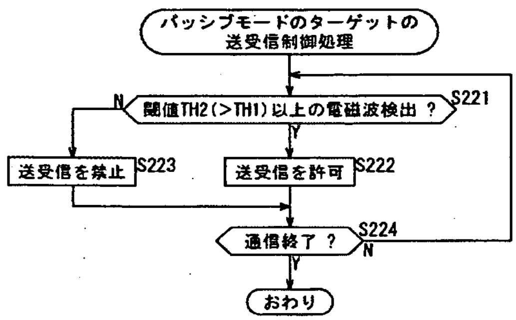
【図２７】

図27



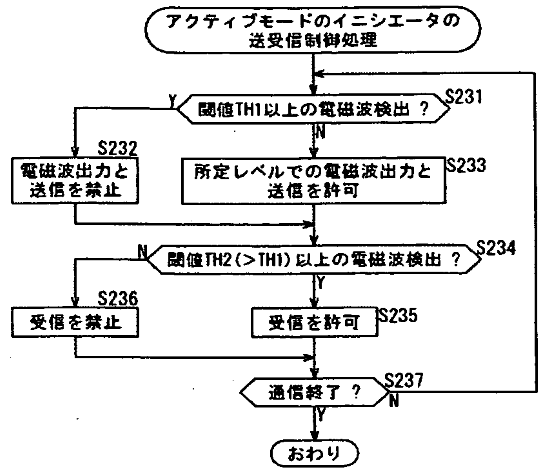
【図２８】

図28



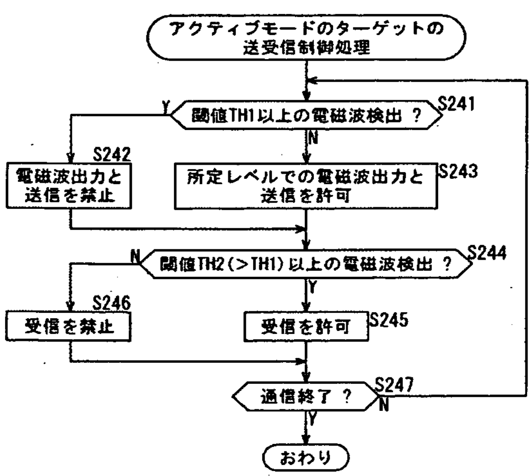
【図２９】

図29



【図３０】

図30



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